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On the cover . . . The Genesis .280 Ackley Improved features a Leupold VXIII 3.5-10x scope in Talley mounts, while the Ruger SR-556 Takedown has a Leupold Mark AR MOD 1 4-12x scope attached. Hill Country Rifle photo by John Barsness.

RIFLE
Sporting Firearms Journal

ISSN 0162-3593

Volume 47

Number 6

Issue No. 283

November 2015

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Circulation Manager – Kendra Newell
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Subscription Information: 1-800-899-7810
www.riflemagazine.com

Rifle® (ISSN 0162-3583) is published bimonthly with one annual special edition by Polacek Publishing Corporation, dba Wolfe Publishing Company (Don Polacek, President), 2180 Gulfstream, Ste. A, Prescott, Arizona 86301. (Also publisher of *Hand-loader*® magazine.) Telephone (928) 445-7810. Periodical Postage paid at Prescott, Arizona, and additional mailing offices. Subscription prices: U.S. possessions – single issue, \$5.99; 6 issues, \$19.97; 12 issues, \$36. Foreign and Canada – single issue, \$5.99; 6 issues \$26; 12 issues, \$48. Please allow 8-10 weeks for first issue. Advertising rates furnished on request. All rights reserved.

Change of address: Please give six weeks notice. Send both the old and new address, plus mailing label if possible, to Circulation Department, *Rifle*® Magazine, 2180 Gulfstream, Suite A, Prescott, Arizona 86301.

POSTMASTER: Send address changes to *Rifle*®, 2180 Gulfstream, Suite A, Prescott, Arizona 86301.

Canadian returns: PM #40612608, Pitney Bowes, P.O. Box 25542, London, ON N6C 6B2.

Wolfe Publishing Co.

2180 Gulfstream, Ste. A
Prescott, AZ 86301

Tel: (928) 445-7810 Fax: (928) 778-5124

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MODERN BULLETS IN THE 7MM MAUSER

SPOTTING SCOPE by Dave Scovill

Research back in the previous century suggested the 7mm Mauser should be more than adequate for use on blacktail, mule deer and elk in the Oregon backcountry. Unfortunately, the relatively new 7mm Remington Magnum was all the rage in those days, and factory 7x57mm Mauser rifles were relatively rare, save for the recently introduced Ruger Model 77. Asking around at various gun shops for a 7x57 usually got blank stares, followed by, "What's that?" So, I made a long-distance call to the Glide Saw Shop, where our old family friend Ben Serafin always kept a few rifles in stock amid the clutter of chain saws, logging gear, plumbing supplies and who knows what under an ever-present blanket of dust.

When asked if he had a Ruger Model 77 7mm Mauser on hand, Ben replied, "Sure, how many do you want?" I assured Ben that one would be sufficient, and I would be there early the next day.

The Ruger 7x57mm Mauser proved satisfactory for deer and bighorn sheep, albeit allowing for the .495-inch throat that was standard in those days to accommodate the long 175-grain roundnose, military-style bullets that in civilian mode behaved more like a bludgeon than a bullet when they slammed into Oregon's midsized black-tailed deer.



Rifles include (left to right): Winchester post-64 Model 70 with open sights, Remington Model 700 with a stock from Stocky's and Ruger M77 7x57mm Mauser with the Pedersen barrel.

In time, most of the 7mm bullets on hand in local shops were tried in the Ruger, including the 120-grain Hornady hollowpoint, Speer 130-grain softpoint, Sierra 140- to

160-grain GameKings, Hornady 139-, 154- and 162-grain Spire Points and the Speer 160-grain Hot-Cor. Oddly, the shorter 120- and 130-grain bullets seemed to provide best accuracy in spite of the free-bore effect of the long throat. Longer/heavier bullets shot well enough for normal hunting chores, but even they couldn't be seated out to what pundits of the period recommended to achieve any hope of best accuracy in long throats.

During the experimenting with the 7x57mm, I was managing a ranch for an owner who lived in southern California, and the previous manager put in several hundred acres of alfalfa, whereupon the mule deer from the national forest lands invaded the fields. I suggested the owner might like to put in for a few depredation permits to cut the deer population down a bit. He agreed, and that led to a few contacts with other ranchers in the area, and the Mauser got a lifetime worth of work in a few months of culling deer.

Unfortunately the Ruger, along with the Weaver 6x scope, was stolen and that put a stop to more work with the 7mm Mauser until it was replaced with another Ruger, which I gave to my son Jason, and a third rifle that was a bit of a stinker and was given to John Barsness and subsequently rebarreled. A fourth 7mm was acquired a few years back with the idea that it might prove interesting to change the throat length, which by that time SAAMI had reduced to a much shorter length, although the standard remains somewhat elusive — Ruger at .256 inch, Remington with .267 and Winchester with .363 inch, depending on the length of the case (2.225 to 2.235 inches) and how far a flatbase bullet can be seated

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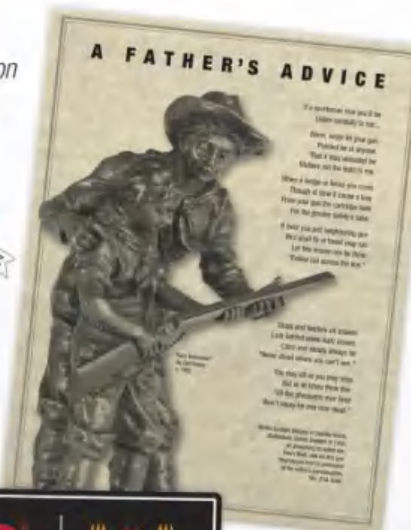
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Rifle: 6.5-06 Ackley

Load Specs:

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Powder: H4831

Action: Win Model 70

upside down and butt into the end of the throat.

As it turned out my wife, Roberta, bought a Remington Model 700 (with the .267-inch throat) from Ken Waters, which was also about the time some of what I refer to as “Super Bullets” (SB) that are designed for speed and penetration started to show up in product lines from various manufacturers.

The Barnes Triple-Shock, which evolved from the earlier solid copper X-Bullet, was the early pioneer in the SB concept followed by (not necessarily in order) the Swift Scirocco that became the Scirocco II and the Nosler Accu-Bond, both with thick gilding metal jackets and thin lead cores, and Nosler E-Tip and Hornady GMX with hollowpoints capped off with a poly tip in a solid gilding metal body. Federal offers a Trophy Bonded Tip with a lead core and a poly tip with a grooved gilding metal/nickel-plated body that, like the others mentioned, are long for their weight, but as this is written may not be available to handloaders. Also included in the SB lineup would be the various match bullets that generally come in heavier weights for any given caliber, and the Berger VLDs in mid- to heavier weights, e.g., 140 to 168 grains in 7mm.

The common denominator with all the above is that they are long for their weight and, as such, make it necessary to seat them a bit deeper into the case than their standard lead-core counterparts. The irony is that the SBs have appeared at a time when the long .495-inch 7x57mm chambers that would have accommodated them easily have long ago given way to the newer, shorter SAAMI chambers mentioned above. This brings us back to the Ruger M77 7x57mm Mauser that has gathered dust in the gun safe for nearly five years.

The first order of business with the Ruger, upon my retirement, was to ask Danny Pedersen (Classic Barrel & Gun Works) to make



Flatbase bullets are seated upside down (left to right): to original Mauser throat length, .400 inch in new Ruger barrel, Winchester Model 70, Remington 700 and Ruger Model 77.

a 26-inch chrome-moly 7mm barrel. That would take a couple of months and offer time to work with various theoretical throat lengths for the lineup of 7mm bullets, mostly from 140 to 168 grains, flat-base and boat-tail designs. The seating criterion was to ideally have something close to one caliber seating depth, which doesn't include the boat-tail, because it does not contribute to bullet pull, i.e., contact between the bullet body and the case neck. At least one factor in the seating depth requirement was that the chamber reamer would/should produce a throat diameter of .285 inch (± 0.0005 inch), so the idea of seating the bullet as closely as possible – or as is practical – to the lands would not be so much of a consideration in terms of accuracy, since the relatively snug throat diameter would/should prevent yawing.



Barnes bullets include (left to right): 160-grain TSX, 140 TSX, 150 TTXX, 140 TTXX and 120-grain TTXX.



Nosler bullets include (left to right): 140-, 150- and 160-grain Partitions, 160- and 140-grain AccuBonds and 150- and 140-grain E-Tips.

Another consideration was that by not seating the bullet any deeper than necessary into the case neck, it should be possible to avoid some of the overly compressed powder charges that occur in chambers with .25- to .3-inch throats, especially with boat-tails and poly tips, which in most 7mm cartridges cause the bullet to be seated even deeper, owing magazine length and/or proximity of the bullet's

ogive to the rifling, i.e., location of bore diameter measurement on the nose of the bullet.

Consideration was also given to the fact that Barnes recommends seating its TSX and TTSX bullets .035 to .050 inch off the lands, a recommendation that is probably pretty close to practical for the other monolithic bullet designs. For example, Nosler E-Tip data shows it is seated .030 deeper than other Nosler designs for the 7x57mm, so it makes sense to



Left to right: Hornady 120- and 139-grain Spire Points, 139-grain InterBond and GMX; Swift 140-grain A-Frame and 150-grain Scirocco II; Hornady 162-grain National Match; Berger 140-grain VLD; Winchester 160-grain Fail Safe (discontinued); and Speer 160-grain Trophy Bonded.

defer to factory recommendations with the newer SB designs.

Depending on the angle or slope of the bullet ogive, it is possible to have a leade angle on the lands/rifling in front of the throat that makes first contact on the groove or bore diameter portion of the bullet, or both simultaneously, where the chamber/throat/leade are designed to fit one particular bullet design. As stated above, however, the goal in the Ruger project was to accommodate the most practi-

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cal range of bullet weights and designs and to avoid deep seating with mid- to heavier-weight bullets in so-called modern 7mm Mauser chambers.

In the final analysis, no matter what throat length is used, it's a compromise between seating depth, hence powder capacity. For most of the 140- to 160-grain SBs, a .400-inch throat length offers about one caliber seating depth or

slightly more where the boat-tail extends below the case neck. At that length, the 150-grain SBs are about ideal, acknowledging that a 150-grain E-Tip is about the same length as a 160-grain AccuBond. This also backs the bullet away from the lands far enough to avoid pressure spikes with the relatively hard, compared to traditional lead-core, monolithic bullet designs. This works out about right for the Swift Scirocco and Barnes 150-

grain bullets as well. The lighter 120- to 130-grain bullets will have to jump a bit to reach the lands, assuming a one-caliber seating depth, but experience suggests a snug throat diameter and little (.003 inch or less) or no bullet runout helps maintain accuracy. This also assumes that case neck runout is minimal as well – before the bullet is seated.

It is necessary to measure case head expansion when working up loads, especially where powder charges exceed recommended maximum for the bullet(s) in question listed for rifles with shorter SAAMI throats. This isn't guesswork; it requires actual measurement just in front of the extractor groove, short of the expanded web area, with previously unfired brass. Anything over .0005 inch case head expansion is generally considered to be pushing the limit. And don't forget the Barsness rule, for each four-grain increase in powder capacity (by seating the bullet out), about 25 percent, or one grain, actually results in increased velocity, assuming constant pressure. This is why this project includes a 26-inch barrel and in reality is the easiest way to gain about 100 fps over a 22-inch factory barrel.

Since all 7x57mm Mauser rifles manufactured in the last 35 years or so (the date of the changeover to the shorter SAAMI throats isn't known for sure) have .25- to .33-inch chamber throats and are offered in standard '06-length actions (3.34 inches) to accommodate an overall loaded length of 3.2+ inches, it is a relatively simple chore for a gunsmith to use a throat reamer to extend it from its current length out to any length short of .5 inch – or beyond if it strikes your fancy.

Load data published in the last few years is held to approximately 46,000 psi in deference to the older Model 93 and 95 Mausers that were manufactured in large numbers and still in use. Some data goes up to 50,000 psi, but don't assume anything unless the higher pressure is mentioned in the text. The 1982 third edition of the *Hornady Hand-*

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The Nosler E-Tip was seated to 3.218 inches OAL for the Pedersen 7mm Mauser barrel (left) and 3.015 inches OAL (right) as per Nosler.

book of *Cartridge Reloading* (prior to the advent of SBs) is probably the best reference, if you can find one. The 25th edition of the *Hodgdon Powder Data Manual* (1986) lists "7x57mm Mauser Heavy Loads for the Ruger Only" with

Hodgdon, IMR and Winchester powders but doesn't list overall loaded length (OAL). The Hornady manual, however, holds OAL to 3.00 inches for bullets of 120 to 162 grains and 3.015 inches for its 175-grain roundnose in a Ruger M77 with a 22-inch barrel. Respective maximum velocities of interest are 2,900 fps with the 139- and 154-grain Spire Points and 2,800 fps for the 162-grain hollowpoint boat-tail. A trial workup with W-760 reveals 3,000 fps (plus/ minus) is a practical goal with 139/140-grain bullets with an OAL around 3.2+ inches in the 26-inch Pedersen barrel.

In a discussion with Danny Pedersen, the subject of other options came up, including the .284 Winchester, .280 Remington, .280 AK Improved, 7mm WSM, 7mm Remington Magnum, 7mm Weatherby Magnum and big boys like the 7mm STW, 7mm RUM and .28 Nosler, all of which require cramming 140-grain and heavier SBs into the case body out of deference to OAL requirements in respective action lengths. The 7mm-08, of course, is chambered in short actions and necessarily limited to 2.85 inches OAL. It is quite ironic that the ancient 7x57mm Mauser is the only one of the lot that can be easily adapted to the use of modern SBs without a loss of efficiency. R

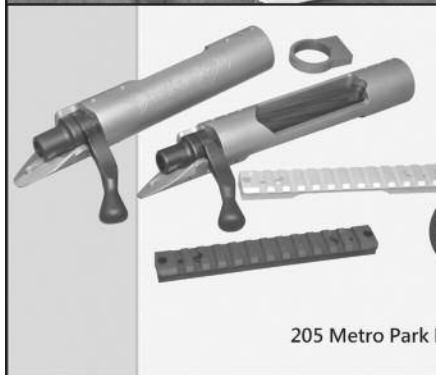


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LEVERGUN SIGHTING AND SHOOTING

MOSTLY LONG GUNS by Brian Pearce

The lever-action rifle holds a special place in U.S. history. It helped settle the western frontier and throughout the country was highly regarded for its handiness, versatility and reliability. It also became popular in many other countries. Countless millions have been sold, and today it still remains widely used among big game hunters and guides, but it also serves credibly in the role of defense and for those who just enjoy collecting and shooting classic rifles.

Shooting leverguns accurately from a benchrest or sandbag rest is distinctly different and much more challenging than firing bolt-action rifles featuring a one-piece stock design. Many times I have received requests by readers and friends to cover this topic, and it is with a certain reservation that I share my thoughts, as variances in barrel length and weight, caliber, recoil and other factors come into play that may change the technique used for a particular rifle.



Using quality sights or scopes on leverguns will help achieve tight groups.

Nonetheless, a few general tips might help get a rifle zeroed, produce tight groups and allow it to hit the same point of impact from common field positions.

Many of the same principles and techniques that apply to shooting

bolt-action rifles from a rest also apply to leverguns. For example, the sights – whether scope, aperture or open iron – should be of good quality and properly mounted. The stock screws should be tightened with the correct inch-pounds of torque. The holding method, including grip, stock-to-shoulder position and pressure, cheek weld, etc., should be as closely duplicated from shot to shot as possible. A good trigger pull, preferably between 2 to 3 pounds, that breaks crisply and cleanly will help prevent rifle movement when it breaks. Taking several deep breaths, let half out then hold while aligning sights and carefully squeezing the trigger (even between heart beats if possible) is sage advice. A good “follow through” after the trigger breaks is essential and possibly even more important with leverguns due to their comparatively slow lock time and generally lower velocity cartridges that result in longer barrel time for the bullet.

Leverguns can also be sensitive



Right, many quality front sights are available to best serve in a variety of shooting circumstances. Two popular examples include the traditional gold bead (left) and X-S white stripe (right).

Left, modern aperture sights have become widely popular on leverguns. They are lightweight, tough and fully adjustable for windage and elevation. Examples include (top to bottom): X-S, Skinner Sights and Williams.



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When sighting in from a sandbag rest, Brian rests his left hand on the bag and holds the forearm tightly. Pulling the rifle back firmly against the shoulder produces a similar point of impact as most field positions.



to barrel heat. For example, I have rifles that will "walk" the shots as the barrel heats, but others can be shot until they are so hot they cannot be touched, and bullets stay centered and groups seem to only increase slightly. Generally speaking guns with "rifle" forearms and magazine tubes are less hot-barrel sensitive than carbines featuring the typical double barrel bands. Nonetheless, it is suggested to allow the barrel to cool between shots, or at the very least, don't shoot for accuracy when it is hot.

Some guns are sensitive to how many cartridges are placed in the tubular magazine, as this changes the weight on the barrel and balance. If a rifle features a full-length magazine, I usually only load between two and four cartridges in the magazine when shooting from a sandbag rest, or when hunting, since more cartridges are rarely needed.

One feature of leverguns is that they often shoot away from the rest, or bounce excessively, which virtually always results in poor groups or fliers. I have seen this occur even with light calibers, but it is often more pronounced with big-bore, heavy-recoiling cartridges, such as +P-style loads in the .45-70, .50 Alaskan and similar cartridges. This problem seems even more magnified when the sandbag is positioned too close to the receiver or too far forward past the forend tip. I generally position the sandbag somewhere directly under the forearm tip, but rather than resting the forearm directly on the sandbag, I place my left hand just under the forend cap, resting the hand on the sandbag, then grip the forend tightly and use that hand to pull the rifle back firmly to my shoulder. If the rifle touches the sandbags, groups will likely open. This position cradles the rifle in a similar position that is used in the field, such as standing or using a log or large rock as a rest. (In the field, the rifle is never rested directly on any rest; the hand is the only contact point.) The above bench shooting method also helps control barrel lift and recoil.

With the buttstock firmly planted against the shoulder, there is no

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need for a rear, or buttstock sandbag rest. In fact, I never rest the buttstock on sandbags, or groups will open substantially. I do occasionally place a small pad under my right elbow to minimize the jarring effect produced by big-bore cartridges.

Using this shooting method will also result in a similar bullet point of impact when the rifle is fired in common field positions, including sitting with elbows supported by the knees, standing or a makeshift rest, as long as the rifle is grasped and shouldered with similar pressure.

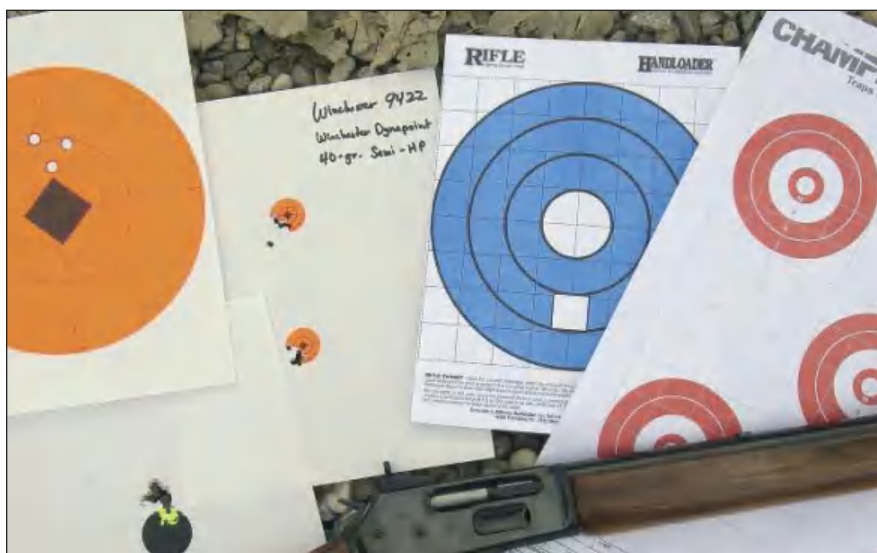
Most shooters who choose to mount a scope on leverguns generally opt for a fixed-power compact or low-power variable. The crosshairs of these low-power scopes will often cover the bullseye of many common paper targets at 100 yards, as they are generally intended for scopes with greater magnification. Select a target that corresponds with the crosshairs

and that will allow exact duplication of the sight picture for each shot.

When using open iron or aperture sights, which substantially increase accuracy under all light conditions, target choice is essential to accurate shooting. The front

sight should correspond with the target to allow a precise sight picture. A common mistake is to use a target that is too small. For 100-yard shooting, I prefer a 6-inch bullseye but have also used 8- and 10-inch sizes with good results, de-

(Continued on page 67)



Choosing a paper target that corresponds with the size and shape of the front sight is critical to achieving good levergun accuracy.



PAPER TARGETS

DOWN RANGE by Mike Venturino

On the surface, a target is merely a mark placed at some distance at which to shoot. In reality, the subject of targets is far more complicated. Paper targets can be single, round bullseyes, multiple bullseyes or oddly shaped aiming points, such as animal silhouettes. Their bullseyes can be white, blue, black, red, orange or multicolored. Some are ideal for load testing or group shooting. Others shine for sighting in scopes, because they have a grid by which to judge scope adjustments. The purpose of some other targets is to learn to direct a bullet precisely to a given spot – as in hitting an animal outline in what would be the vital area of a real animal.

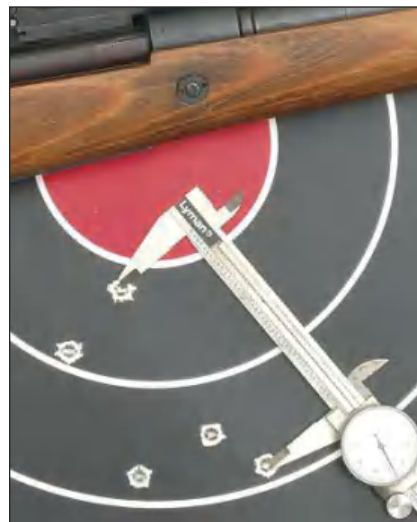
No one type of target works perfectly for all types of shooting, which is something I've learned over a half-century of using targets. It's also the reason my "shooting shack" contains a large variety of paper targets, and my shooting range has target berms at various distances.

As a gun writer, the targets most useful are round bullseye types, but even here many types are needed. Just yesterday, upon trying out a new-to-me rifle with



Targets with colored aiming points and a grid pattern are optimum for scoped rifle sight in.

military peep sights, I put up a National Target SR at 100 yards. This version has a 13-inch black bullseye, but its total dimensions are 42x42 inches. The reason for so much paper at only 100 yards was because I had no idea as to the rifle's point of impact in relation to point of aim and did not want to waste time and ammunition getting it on paper. If the large SR target had not been available, a backup plan would have been to shoot the rifle first at 25 yards. I consider a big 100-yard target a better starting point.



The new breed of targets that highlights bullet holes are vastly easier for spotting hits.

As luck would have it, that particular rifle was putting bullets close to point of aim. So, the next step was to put a Birchwood Casey "Big Burst" target with an 8-inch bull at each of the SR's corners. Thusly, several different factory loads were fired for groups without having to go downrange again.

As a full-time gun writer (meaning time is valuable), my common target setup when there is plenty of shooting on the agenda is to staple five of the National Targets' A25s side by side. These are 14x42-inch strips of heavyweight paper with three, 8-inch bullseyes. That gives 15 aiming points that are usable with open, peep or optical sights. Since I usually go to my "shooting shack" with multiple rifles, my method is to set the rifles upright to the left of my shooting bench. Then one is fired for group and set aside to cool while another is fired, and so forth. One factor, however, learned by experience, was that a log of which bullseye was fired by which rifle was necessary.

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(Continued on page 66)



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PICATINNY APPLICATIONS

LIGHT GUNSMITHING by Gil Sengel

In the last column we looked at where the Picatinny rail came from. Also mentioned was that not everything that looks like a Picatinny rail is actually made to the proper dimensions. The same is true for devices that clamp to the rail. It's best to check any new gadget to be certain fit and locking are secure.

While the reason for the Picatinny rails being is to quickly attach and detach devices to military arms, there is another use. Largely overlooked is its usefulness on sporting firearms. Weaver rings fit the Picatinny base perfectly.

For example, scopes are getting shorter and have more knobs, rings and switches protruding from their tubes. Bases having only two points to attach the two rings are becoming difficult to use. The increasingly popular red-dot sights, on the other hand, have no rings. Instead, they have integral clamps from two to three inches long that grip a base attached to the gun.



The M91 Mauser receiver ring was reshaped, off-center holes were plugged and proper holes drilled wherever there was solid metal. No commercial base will now fit.

A Weaver one-piece scope base can sometimes be made to work, but position of the dot sight is never ideal.

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Attaching a Picatinny rail to the rifle changes everything. Rings may be placed where they must and still line up with a cross-bolt slot in the rail. Red-dot sights can be clamped anywhere along the rail. This is important because, while these devices have no eye relief as such, the closer they can be positioned to the eye, the easier they are to use.

The downside of all this is that the number of Picatinny bases made to fit popular sporting rifles has been small but is increasing. The Brownells base with dot sight on the DST Mauser M98 may give collectors indigestion, but the base can also hold short, modern scopes due to the multiple cross-slots. The same is true for the Remington Models 721 and 722 (not shown). My 722 is a .222 Remington that will mount a dot sight for critters called in close, while a big wildcat chambering in a long action 721 needs a large, high-powered scope; both needs are met by Picatinny bases. Brownells' bases are also available for Winchester Model 70s and Savage 110 rifles. All have the benefit of TORX head mounting screws as well – a definite plus.

Other interesting entries are Picatinny bases for the Remington Model 760, Browning A-Bolt, Ruger Mini-14 and Marlin 336 series actions. These bases are also listed for scout-scope applications that extend out to, and anchor in, the rear sight dovetail of Marlin Models 336, 1894 and 1895. The list keeps growing, and these

are just rifles. Many more bases are available for shotguns and handguns but require drilling and tapping.

Of course, I haven't mentioned the Ruger 10/22. Bases are available in standard and long length plus those that extend over the front and rear of the receiver. There was no example for a photo, as I just don't see the use for dot sights and high-dollar scopes on a 10/22. Others disagree. Kids like them though, which brings us to the next item.

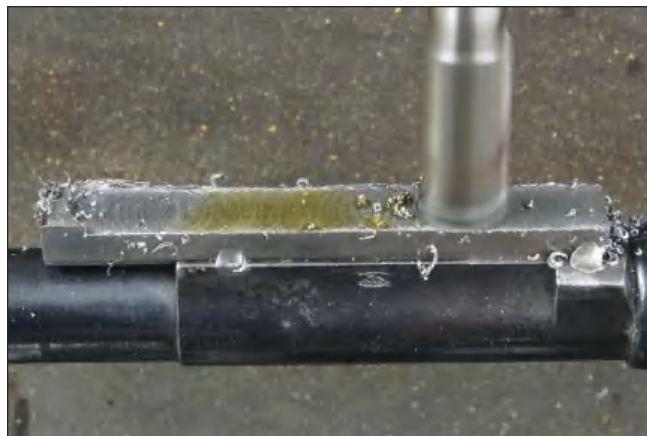
The Brownells catalog contains a listing for a two-piece KWIK-SITE base set. It is two .875-inch long



The military rear sight base has also been ruined. To provide something to attach a rail to, a piece of steel was fit into what was left of the rear sight base.



The steel was welded in place – this isn't a \$5,000 sporter.



The steel insert was then milled to the same height as the receiver ring.

bases, each having a .150-inch wide cross-slot. This isn't Picatinny specifications, but neither are the cross-bolts of most red-dot sights. These and Weaver rings work just fine.

placeable with a more useful low-power scope.

Now for the most important use of the Picatinny rail from the gunsmithing point of view: custom

fect, the rifle appearing to have been in nearly new condition before the "work" began. Enough repair has been done to make it fire, but there is no way to mount



The insert is drilled, tapped and a piece of Brownells rail blank (foreground) is fit and cross-slots cut.



With a dot sight in place, its owner has a fast-sighting, 200-yard game rifle.

The bases slide onto any standard $\frac{3}{8}$ -inch dovetail of .22 rimfire receivers. Bases can be slid together or apart to fit most any dot or scope sight. Kids can use the electronic stuff, which is instantly re-

scope mounts. Readers may recognize the M91 Argentine Mauser. It has appeared before and is the best example of the old term "kitchen table gunsmithing" I have ever seen. Sadly, the bore is per-

sights, because several holes were drilled in the receiver ring and bridge, none of which were in line with the bore. The bridge has also been ground away to the point that a lot of welding will be required to make it right. The project is coming to resemble the story of the fellow who took his \$50 bird dog to a trainer, spent \$500, and still had a \$50 bird dog.

However, I wanted to shoot the thing! This would be a tad difficult because there was also no front sight, and the military rear base was nearly filed away. The only reasonable cost solution involved a Picatinny rail.

First a block of mild steel was filed to fit tightly inside what was left of the rear sight base. Permanent attachment was by TIG welding at each corner, as this would not disturb the solder holding the sight base to the barrel. The

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A neat Picatinny adaption is this two-piece set that fits dovetailed .22 RF receivers. It can be slid and clamped to fit any electronic device. This example leaves Gil cold, but kids love it.

block was milled to the same height above center of bore as the receiver ring, then drilled and tapped for two 6x48 tpi screws. The receiver ring was given two holes wherever they could be placed to miss the plugged, off-center ones.

A 7-inch length of aluminum Picatinny base stock was then cut from a 24-inch bar sold by Brownells (stock no. 296-000-098). This is unslotted, but it is also available with slots. The base was filed a bit on one end to fit the receiver ring, then drilled to match the holes in the ring and sight block.

Locking bolt cross-slots were cut on a milling machine; a two-flute end mill in a drill press cuts the aluminum easily if one goes slowly. There is no need to meet Picatinny specifications either if only Weaver rings will be used to attach a scope.

While the M91 is a bit extreme, blank Picatinny bases can be used on hundreds of shotguns, rifles and handguns – the only limit is one's imagination. By the way, the Mauser will hit a pop can every time at 125 yards or so using the dot sight shown. Maybe there is something to these battery-powered gadgets after all!

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SLANTED SCOPES

A RIFLEMAN'S OPTICS by John Haviland

Isuffered several blows to the head as a kid, and to this day my head throbs when a storm front begins to move in. Those injuries may have also caused a misalignment of my eye and brain, because everyone who looks through scopes on my rifles says I mount my scopes with the crosshairs slanted to the left of vertical. They say I should get my head examined if I ever hope to hit anything.

Holding a scope's sight other than vertical to the center of a gun's barrel bore can result in bullets hitting somewhere other than where we aim. The more the sights are turned from vertical, the farther a bullet will move away from aim. This bullet shift away from aim is amplified by distance and shooting relatively slow bullets, because of their steep trajectory curve.

A normally sighted firearm has both its sight and barrel bore aligned in a vertical plane. As a bullet drops, it falls through the line of sight and to the target. With the sight slanted, a bullet's trajectory departs from that alignment, because the bore is pointed to the side. A bullet fired from a rifle with a canted scope alignment fails to reach the highest elevation of the vertical trajectory. It also hits to the left or right of point of aim. Many explanations of how sight canting alters bullet impact include all sorts of calculations and diagrams with lines pointing every which way.

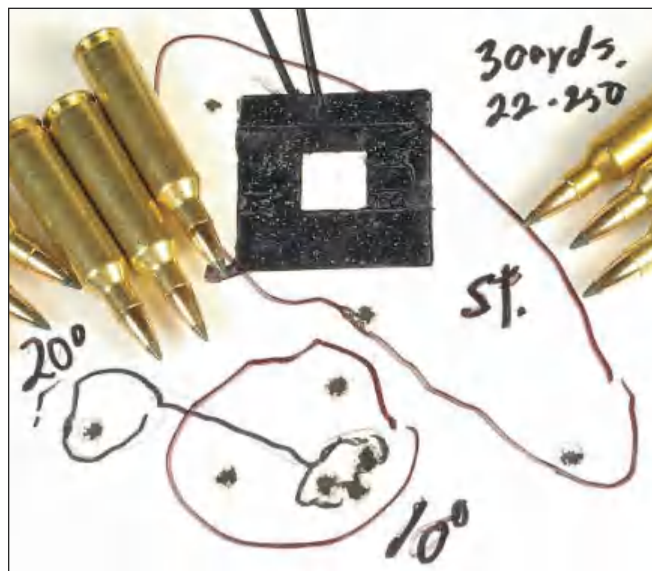
To my eye, crosshairs in my scopes are straight up and down; it's the rifle that is slightly tilted. As long as the sights are held the same for every shot, bullet impact remains constant from near to far. But where



The slow velocity of .22 LR bullets accentuates bullet shift. A 20-degree slant to the sight is enough to cause a miss on a ground squirrel at 100 yards.

will bullets hit if crosshairs are tilted when a hunter quickly brings his rifle to bear to fire a hurried shot at game or from an unsteady and impromptu position?

To determine if off-kilter sights would result in missing next season's buck, three different rifles firing bullets with various velocities were used with the sights canted approximately 10 and 20 degrees to the left. To set that amount of slant to scope crosshairs, the rifle was leveled and a protractor placed horizontal to the upright scope and the scope then rotated left to match the protractor's arm positioned to the appropriate amount of pitch. The top of the vertical crosshair was lined up on a mark on the target backboard and the crosshair on the center of the target to keep the proper angle for each shot.



At 300 yards, bullets fired from a .22-250 Remington start to shift to the side when the crosshair is not held vertical.



At 300 yards, 85-grain bullets fired from a .25-06 Remington show quite a bit of shift the farther the sights are turned from straight.



While taking a long shot, a hunter should spend a couple of seconds to make sure his sights are straight to keep bullets from hitting other than where he aims.

The rather slow velocity and steep trajectory curve of .22 Long Rifle bullets shows the farther sights are turned from vertical, the farther bullet impact moves away from point of aim. With a 10-degree tilt, bullets hit 1.40 inches left of aim at 100 yards. Twice the cant, 20 degrees, resulted in double the shift. Another time I shot 40-grain roundnose bullets with a muzzle velocity of 1,200 fps sighted dead on at 50 yards. There was no vertical shift of the bullets at 50 yards, but at 100 yards the bullets hit somewhat above aim. The bullets should have hit low because of gravity pulling them down 6 inches between 50 and 100 yards. I put a Laserlyte bore sighter in the .22's muzzle. With the scope's vertical crosshair straight, the sighter's red dot and junction of the crosshairs lined up at 50 yards, but with the vertical crosshair rotated left, the red dot pointed above the intersection of the crosshair.

A Cooper Firearms .22-250 Remington produced next to no bullet shift at 100 yards when it was shot with the crosshairs straight and at an angle. Eight bullets landed in .78 inch, and all nine bullets grouped in 1.19 inches. Some change in horizontal bullet impact appeared at 300 yards. A 10-degree cant moved bullets 1.60 inches to the left, and 20 degrees of tilt added another inch of left movement. Some additional bullet drop should have occurred with the slanted holds, but none appeared.

The effects of canted crosshairs

certainly showed up shooting a .25-06 Remington at longer distances. At 100 yards, nine 85-grain Ballistic Silvertip bullets landed in 1.30 inches with the crosshair vertical *and* slanted. Just a hint of drift to the left occurred with the crosshair tilted 10 and 20 degrees compared to vertical. At 300 yards,

groups marched down and to the left with the crosshair tilted. A 10-degree slant moved bullet impact nearly 3 inches left and 2 inches down from a vertical hold. A 20-degree slant altered bullet impact 5 inches to the side and 3 inches low.

This shift is not linear. The height of the bullet above line of sight rises quite a bit to hit on aim at longer distances. Tilt the sight, and the .25-06's trajectory path is altered enough to not only miss a marmot sunning itself at 500 yards but also the rock it's perched on. With long shots, though, a few seconds are usually available before firing to make certain a rifle is steady and the sights are square. Such a small amount of bullet shift occurs at short range from slanted sights, I'm not going to worry about it. R

Point of Impact Shift Results

The following shows bullet impact shift from center at 100 and 300 yards with scope reticles canted 10 and 20 degrees left of vertical:

Cooper Firearms Model 57M, .22 LR

Sight: Leupold VX-1 2-7x 28mm mounted 1.25 inches above center of bore

Load: Lapua X-ACT .22 LR 40-grain roundnose, 1,050 fps.

Distance: 100 yards

Bullet departure from vertical crosshair:

10 degrees	20 degrees
1.40 inches left, 0 elevation	2.80 inches left, 0 elevation

Cooper Firearms Model 22, .22-250 Remington

Sight: Sightron SII Big Sky 4-16x 42mm mounted 1.50 inches above center of bore

Load: Nosler 55-grain Tipped Varmageddon, 3,700 fps

Distance: 100 yards

Bullet departure from vertical crosshair:

10 degrees	20 degrees
0 inch left, 0 elevation	0 inch left, 0 elevation

Distance: 300 yards

Bullet departure from vertical crosshair:

10 degrees	20 degrees
1.60 inches left, 0 elevation	2.60 inches left, 0 elevation

Ruger M77, .25-06 Remington

Sight: Leupold VX-3 2.5-8x 36mm mounted 1.30 inches above center of bore

Load: Winchester Supreme 85-grain Ballistic Silvertip, 3,400 fps

Distance: 100 yards

Bullet departure from vertical crosshair:

10 degrees	20 degrees
0.6 inch left, 0 elevation	0.75 inch left, 0 elevation

Distance: 300 yards

Bullet departure from vertical crosshair:

10 degrees	20 degrees
2.90 inches left, -1.90 inches elevation	4.90 inches left, -3.00 inches elevation

THE Genesis



The Hill Country Genesis is a combination of traditional and cutting-edge design. Its Stiller action is a Remington 700 "clone" designed to fit into any stock that fits the Model 700.

John Barsness

The Hill Country of Texas is a geologic region extending west and north from San Antonio, consisting of limestone and granite hills, a few large enough to be called mountains. The slight amount of soil on the rocky hills resembles the skin covering the ribs of a starving cow.

Average high temperatures in July run close to 100 degrees, and irregular rain evaporates or runs off quickly. Consequently, it takes a lot of the Hill Country to grow a cow, and there's not nearly as much oil drilling as in other parts of the state. Without many cattle or much oil, there aren't many people, and small towns are relatively few and far between.

Yet the inhabitants and visitors tend to love the Hill Country, and hunters come to the hills for whitetails that may not grow as large as in other parts of Texas, but due to the wild topography are often more fun to hunt. There are also animals originally from other hot parts of the world, such as aoudad sheep from north-



tion from the lightweight Sheep Rifle for chasing high-mountain game to the heavyweight Tembo for the largest African animals.

The rifle sent along for testing was a walnut-stocked model called the Genesis in .280 Ackley Improved, a sort of combination of classic and cutting-edge. Among the first items noticed in the company's website information about the Genesis was an accuracy guarantee of three shots in .5 inch at 100 yards with "recommended" factory ammunition. I have a somewhat jaundiced view of accuracy guarantees, for a couple of reasons. First, I've encountered too many rifle makers whose rifles don't match the guarantee. The other reason is the shooter: How does a rifle company guarantee .5-inch groups for every customer? However, this isn't about other rifle makers and their guarantees but about one specific Hill Country rifle.

The Genesis created a favorable impression right out of the box.

often isn't as fancy as in other types of walnut, consisting mostly of relatively pale stripes between thinner dark lines, but those shooters who learn to appreciate the other qualities of English walnut also often learn to appreciate its more subtle figure.

It was gratifying to see the Genesis stock wasn't stained to resemble the typical darker brown of native *Juglans nigra* Americans have grown used to on our factory rifles, instead being left as natural as finished wood gets. The 24-line-per-inch checkering was a borderless point pattern, with no run-overs and only a very few "shiners" (flat-topped diamonds) around the bottom edges of the grip panels. The stock shape is basic classic with a cheekpiece, and a one-inch black Pachmayr Decelerator pad and blued pistol grip cap with nicely "timed" screw slots aligned with the centerline of the stock. The epoxy bedding includes the almost-standard aluminum pil-

ern Africa and axis deer from India, which do fine in the Hill Country. Consequently the ridges and canyons hold the same sort of allure to big game hunters as the badlands of the Missouri Breaks or the rocky *kopjes* in the high desert of Namibia.

The Hill Country is quintessential rifle country, so it makes sense for Hill Country Rifles to be located there, in the small city of New Braunfels near San Antonio, the jumping-off point for rifle-toting visitors. The company is well known for the accurizing service provided for factory rifles – I haven't had any of mine done, but friends report excellent results – and also makes a wide variety of custom and semiproduction rifles. Unlike some specialty rifle companies, these include both synthetic and wood-stocked models with both push-feed and controlled-feed bolt actions, in every possible combina-

A .280 Ackley Improved by Hill Country Rifles

The stock is a very nice piece of *Juglans regia*, often called "English" walnut, even though it is native to central Europe. However, the tree spread rapidly during the peak of the Roman Empire and then eventually into North America, especially California. Considered by most stockmakers the finest species of walnut (indeed the finest wood of all) for making rifle handles, *regia* is normally hard, stable and relatively light, with small pores that finish smoothly and take checkering very well. The figure

lars, and I was happy to find the recoil lug wasn't bedded so tightly that the barreled action had to be practically pried out of the stock, as it is on so many custom rifles.

The action, however, isn't classic, instead fitting right into Hill Country's emphasis on accuracy. It's a stainless-steel Stiller, a modern push-feed action with a Remington 700 "footprint." It also happens to be made in Texas, and Stiller actions have gained a fine accuracy reputation over the past several years.

Genesis



Above, the stock includes a blued steel grip cap and stainless bottom metal. Right, the classic-style stock includes a graceful cheekpiece. Below, epoxy bedding and aluminum pillars ensure consistent stock contact with the action.



The bolt is spirally fluted and works slickly, and the extractor is a toggle-type combined with a plunger ejector. The bolt release is also a toggle, located on the left rear of the action. The trigger is a Timney with a two-position safety,

the lever located (like Remington 700s) on the right side of the action tang. Ten of the crisp pulls averaged 31.4 ounces on my Timney scale. The bottom metal is also stainless steel with the floorplate release inside the trigger guard.

Hill Country doesn't reveal the exact brand of the medium-weight, 24-inch stainless barrel, only stating it's "match-grade." My Hawk-eye borescope revealed a nicely lapped bore with a cleanly cut chamber, the beginning of the lands even all around the throat. (This is to be expected, but expectations aren't always fulfilled, even

in custom rifles.) The barrel was also correctly and evenly free-floated in the forend channel.

Nicely made, good-looking rifles, however, still need to be shot, since that's the primary purpose of a hunting rifle. The Genesis came equipped with steel Talley scope-mount bases, so steel Talley rings were used to mount a 10-year-old Leupold VX-III 3.5-10x40 that's always been very reliable. Nosler had sent along some of its Custom handloaded factory ammunition, along with empty cases and new AccuBond Long Range (ABLR) bullets. After putting together handloads that shot well in other .280 Ackley Improved rifles, I headed to the range one nice afternoon in early July.

It hurts a little to say this, but the smallest group fired turned out to be with the NoslerCustom ammunition loaded with 140-grain Ballistic Tips. However, my handloads weren't tuned to this particular rifle, and all but one also shot well under an inch. (The sting was also reduced a little by remembering something John Nosler told me a few years ago, that after shooting thousands of combinations of bullets and powder in the indoor

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Left, the bolt is a modern push-feed design with a toggle extractor and plunger ejector. Right, 10 weighed pulls of the Timney trigger averaged slightly less than 2 pounds.



Nosler ballistic lab, they tend to know what works in various cartridges.)

The rifle shot well, but none of the groups measured as small as half an inch. I wasn't too worried about this because throughout the session an erratic breeze blew from left to right across the range, and despite putting out a BRT wind flag, my trigger finger got caught by an unexpected gust a few times. Most of the loads shot really well anyway, with the largest group of slightly over an inch coming from the Nosler 175-grain ABLR, and

my experience with ABLRs is they usually require some experimentation.

It should also be noted the magazine of the Genesis left plenty of room even for the rounds loaded with the very long and tapered 175-grain ABLRs. All the loads fed easily and slickly from the magazine, something that doesn't always occur with steep-shouldered Ackley Improved cases.

After all that shooting, I decided to head home and clean the bore, then return the next day and shoot more of the 140-grain Ballistic Tip ammunition, just to see what the rifle could really do. Plus, I hoped the wind might lie down a little the next morning.

Instead it was gusting a little harder, and after an initial fouling shot, three, three-shot groups averaged .65 inch, slightly larger than the group from the day before. The two largest groups, however, were definitely strung horizontally,

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Genesis

The final three groups with Nosler 140-grain Ballistic Tip factory loads averaged a little over .5 inch, but two were strung horizontally due to a gusty breeze. Vertical dispersion averaged less than .5 inch.



.280 Ackley Improved Handloads

bullet (grains)	powder	charge (grains)	overall loaded length (inches)	muzzle velocity (fps)	100-yard group size (inches)
140 Barnes TSX	Hunter	61.0	3.238	3,195	.78
150 Nosler Ballistic Tip	H-4831SC	60.5	3.301	2,948	.63
160 Sierra GameKing	H-4831SC	59.0	3.159	2,832	.75
175 Nosler ABLR	IMR-7828 SSC	58.0	3.307	2,800	1.03
140 NoslerCustom Ballistic Tip factory			3.247	3,212	.61

Notes: All handloads used Nosler cases and Winchester Large Rifle primers.

Be Alert – Publisher cannot accept responsibility for errors in published load data.

no doubt due to the wind. The vertical dispersion of each group was less than .5 inch, including the first group from the previous day, all four groups averaging .37 inch from top to bottom. Based on that, I'm willing to bet fairly serious money this rifle would indeed average half an inch or less on a calm day. It would also seem reasonable for Hill Country Rifles to add NoslerCustom 140-grain Ballistic Tip ammunition to its list of recommended factory loads.

With the 12-ounce Leupold scope and steel Talley rings, the rifle weighed 8.75 pounds. This isn't a lightweight hunting rifle, but a lot of hunting rifles made today weigh far more. It's certainly a good weight for longer-range shooting and also would be quite packable in the Missouri Breaks of Montana or rocky *koppjes* of Namibia.

Along with those places, I've been hunting the Hill Country of Texas for quite a while now, long enough to have seen the Nueces River go from full and flowing to basically bone-dry during an ex-

tended drought – and then, during a visit last May, fill back up again thanks to heavy and persistent rains. The dry hills suddenly turned green, like any desert in bloom, which bodes well for the antlers of whitetails and axis deer, along with their delicious meat. I can't think of many rifles more appropriate for going back and hunting the Hill Country than a Hill Country Genesis.

Hill Country Genesis Specifications:

Action: Stiller bolt-action repeater
Stock: English walnut, semigloss finish
Cartridge tested: .280 Remington
Ackley Improved
Chamberings available: from .25-06
Remington to .338 Winchester Magnum
Barrel length: 24 inches
Weight: 7.75 pounds without scope
and mounts
Finish: bead-blasted stainless steel
Price: \$5,995
Manufacturer: Hill Country Rifles
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RWS

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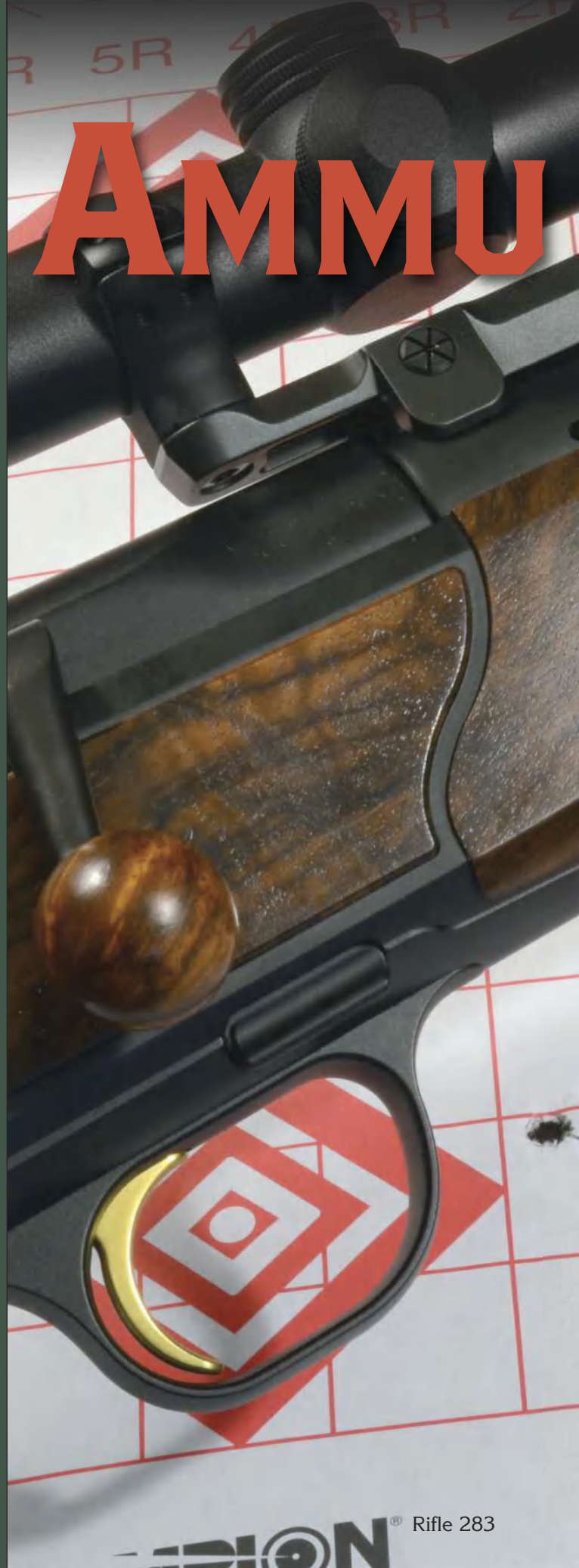
Terry Wieland

Determining accuracy is one of those subjects on which shooters will never agree. There is no accepted definition of pure accuracy, and what is considered wonderful in one rifle is lamentable in another. The problem of testing ammunition for accuracy is multiplied by the fact that a load that may be spectacular in one rifle is nothing more than mediocre in another. All we can really obtain from accuracy testing of ammunition is an indication that, given the right rifle, it may be very accurate indeed.

Still, riflemen love standards – some yardstick to measure one load against another. Right now, the accepted measure for hunting rifles is the three-shot group at 100 yards, and the magic limit is one inch, or one minute of angle (MOA). A hunting rifle that will deliver sub-MOA performance is top notch; half-MOA is the elite.

Over the years, not only have accuracy standards changed, but also the methods of measuring have evolved – generally in the direction of making lesser rifles look good. There is no question that a great three-shot group is easier to achieve than a five-shot group of the same diameter, and keeping 10 shots inside the desired limit is the province of benchrest rifles.

A century ago, 10-shot groups were a normal method of testing a rifle. These were measured in different ways. The British liked to draw rectangles, with the lines passing through the centers of the outer-most holes; these were referred to as “diagrams,” and gun-makers would quote a diagram of, for example, 2.5x3.2 inches. These were reproduced, actual size, in catalogs and magazines.



NITION

In the U.S., an accepted method was not to view the overall size but to apply “string measurement.” The end of the string was placed in the center of the target, and stretched to each bullet hole in turn, moving the measurement point back to the center each time. When it was finished, the piece of string might measure 18.5 inches, and that was your measurement. This had its advantages in that it differentiated between two groups of identical outer dimensions, giving the



Left, a Blaser R8 .270 Winchester performed well with RWS 130-grain H-Mantle loads. This 10-shot group measured 1.068 inches. Above, test ammunition was: (1) .270 Winchester 130-grain H-Mantle and (2) 154-grain Evolution Power Bonded, (3) .308 Winchester 154 Bionic Yellow, (4) .30-06 154 Bionic Yellow and (5) 184 Evolution Power Bonded and (6) .300 Winchester Magnum 184 Evolution Power Bonded.

nod to a tight group with one flier over a comparable group with two.

Over the years, the 10-shot group gave way to five shots as the accepted yardstick, and sometime in the 1970s, the five-shot gave way to three. The argument is that, for a hunting rifle in the majority of cases, the first three shots are what count. This may be true to a point, but it significantly lowers the bar for achieving a sub-MOA group. It should also be noted that this argument does not hold up even for all types of hunting rifles. A prairie-dog rifle needs to maintain accuracy for 50, 100 or even 1,000 shots per day. A three-shot group tells you very little.

Still Premium After All These Years

RWS AMMUNITION

When analyzed, an average of three, three-shot groups doesn't tell you much more, although that has become the accepted method of conveying accuracy results with both rifles and ammunition. Adopting the three-shot group as a standard has lowered the bar just about as far as it can go in favor of tilt-ing the field for both rifles and ammunition. Where is there to go from here except the two-shot group? Any day, someone is sure to espouse that as a true indicator, complete with arguments about the number of deliberate shots you might get at a big game animal.

Already, there are those who think in terms of one-shot groups. That is not a joke. The one shot they are talking about is the first shot from a cold, clean barrel, and that has considerable validity.

Back to three-shot groups: The question is, if you are going to shoot nine shots, why not shoot them all into one group? It will tell you vastly more about the rifle's capabilities than measuring shots one through three, then four through six and then seven through nine and averaging the three figures. Some pretty ho-hum rifles



Four different calibers with three different bullet types were shot for accuracy.

can look pretty good using that method.

With a hunting rifle, there are other considerations. The "cold, clean barrel" is one. Anyone wanting to shoot a gilt-edged group usually fires one round first, to remove lingering oil and warm the barrel. That can't be done when you're hunting.

Bob Hagel, when he was writing for *Rifle* and *Handloader*, liked shooting groups on consecutive mornings, and taking the average of those. They could be 3-, 5- or even 10-shot groups. He would place two targets atop each other to start with, shoot the first group, replace the top target the next morning, shoot the second group and so on. When Hagel was fin-

ished, he had three individual groups, plus one aggregate group. This simulates hunting conditions admirably, which is what you strive for when testing a hunting rifle or ammunition.

Too often, tests are contrived to make a product look good, rather than really test its typical performance. In a hunting rifle, what counts is what you can expect shot after shot under all conditions. Since none of us has unlimited time, to say nothing of unlimited ammunition, we have to make some compromises, but it's possible to contrive a test that provides more meaningful results than the ubiquitous average of three, three-shot groups.

Last spring, some RWS ammuni-

Results with the .270 Winchester 130-grain H-Mantle: 3-shot, 5-shot and 10-shot groups measuring .923 inch, .933 inch and 1.068 inches, respectively.



A customized Browning High Power .30-06 delivered the best single group: three shots into .590 inch.



RWS Ammunition Test Results

cartridge	bullet (grains)	3-shot group (inches)	5-shot group (inches)	10-shot group (inches)	published velocity (fps)	barrel length (inches)	measured velocity* (fps)	barrel length (inches)	extreme velocity spread (fps)
.270 Winchester	130 H-Mantle	.923	.933	1.068	3,130	25.6	3,067	23	21
	154 Evolution Power Bonded	.959	1.640	1.659	2,755	25.6	2,691	23	27
.308 Winchester**	154 Bionic Yellow	1.107	3.428	3.428	2,675	24.0	2,739	24	11
.308 Winchester***	154 Bionic Yellow	1.302	1.692	1.692	2,675	23.0	2,787	23	23
.30-06	154 Bionic Yellow	.590	1.240	1.240	2,900	23.6	2,730	22	34
	184 Evolution Power Bonded	1.388	1.388	3.042	2,740	23.6	2,673	22	11
.300 Winchester Magnum	184 Evolution Power Bonded	1.225	1.589	2.252	3,050	25.6	2,883	24	19

* Measured velocity is the average of three shots.

** These .308 Winchester loads were fired in the Weatherby Mark V.

*** These .308 Winchester loads were fired in the George Gardner custom rifle.

Notes: Rifles used: .270 Winchester Blaser R8, .308 Winchester Weatherby Mark V, .308 George Gardner custom, .30-06 Browning High Power and .300 Winchester Magnum Sauer 202.

tion was sent for testing by the importer, New England Custom Gun Service. Although the RWS line is extensive, not all its varieties are imported by NECG, and at that time there were shortages of certain calibers to contend with as well. The distributor sent what was on hand, in calibers I could work with. Inadvertently, it was a pretty good random sampling: .270 Winchester, .308 Winchester, .30-06 and .300 Winchester Magnum. In .308, there were two boxes of the same load; in .270 and .30-06, one box each of two different loads; in .300 Winchester Magnum,

The difference between 3-, 5- and 10-shot groups: The 3-shot group (.590 inch) is spectacular, but the 5- and 10-shot groups show what the rifle/ammunition combination is really capable of producing.



one box of one load. The question was, how to structure an accuracy test that was fair to the ammunition, did not stack the result either way and was meaningful given the limited supplies on hand.

Both chronograph and accuracy tests were required, which is asking a lot of one box of 20 rounds. I chose a rifle in each caliber that I knew to be accurate and, in the case of the .308 where I had two boxes, two different rifles.

The method was a variation on Bob Hagel's approach. For each rifle/cartridge combination used, I pinned together three targets on top of each other. I fired one three-shot group, then removed the top target; fired two more shots into target number two (giving a five-shot group); removed that target and fired five more shots into the bottom target, providing a 10-shot group.

Having chronographed each load already, the barrels were warm. Each rifle was then fired in turn, giving them a chance to rest between groups. They didn't cool off, but they didn't overheat either.

Rifles used included the following: Blaser R8 .270 Winchester (21-inch barrel) with a Kahles 3-9x42 scope; Weatherby Mark V .308 Winchester (23.5-inch barrel) with a Leupold VX-II 2-7x33; George Gardner custom rifle .308 Winchester (22-inch barrel) with a Schmidt & Bender scope; Browning High Power .30-06 (22-inch barrel) with

a Leupold VX-III 3.5-10x40; Sauer Model 202 .300 Winchester Magnum (24-inch barrel) with a Swarovski 3-12x50.

The accompanying table tells the cold, pitiless story, but some interpretation and additional comments are required. Some of the ammunition recorded higher velocities than published, while other loads were slower. Mostly, this can be

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attributed to differences in barrel length. One notable fact, however, is the uniformity. The extreme velocity spreads (ES) were quite small, and this is good.

In the accuracy race, it is easy to see the advantages of the 10- and 5- versus the 3-shot group quite markedly. One can debate whether this was a test of the ammunition, of the rifles involved or a combination of the two; and in reality, no one can say. Only extensive testing with a dozen proven rifles and hundreds of rounds of ammunition could really settle it.

The Blaser R8 .270 Winchester was delightfully consistent and easily the best overall performer. In group sizes, it lost only to the .30-06, 154-grain load. That .30-06

load, though, illustrates the advantage of more, rather than fewer, shots. Any rifle on any given day can shoot a tiny group that is a fluke. This system separates the sheep from the goats. The .30-06 continued to perform very well, but not up to its initial indication. I noted, though, that after the first three shots, the next three, if averaged with the first, would have given an average very near .75 inch, and that is gilt-edged hunting accuracy. The final figure was still good, but not that good.

Still, the .30-06 proved itself a very reliable performer. Its final 10-shot group was the shape shooters like to see – an even cluster with no fliers – and it printed both bullet weights to the same point on the target.

In a couple of cases, the 10-shot groups are precisely the same size as the five-shot. Those are not typos. What happened was that the fourth and fifth shots opened the spread, and the next five shots


then printed inside the existing group. To me, this suggests achievement of the rifle/ammunition combination's mean level of performance. Very likely another 10 shots into the same group would not affect the size or shape appreciably.

The extreme size of the two largest groups resulted from two fliers in the one case (.308 Winchester) and three spreading shots in the second (.30-06). Eliminate those five from a total of 70 rounds fired, and the results tighten considerably. Now, if you were hunting, a flier could be a complete miss at long range, and there is no getting around that. The purpose here, though, was to test the RWS ammunition. Standing back and looking at all seven, 10-shot targets, there is not one that I would not cheerfully take hunting tomorrow, with perfect confidence.

* * *

Ever since the introduction of the H-Mantle bullet in the 1930s, RWS has been a leader in the development of premium hunting bullets to fill specific purposes.

Among the ammunition tested, there were some H-Mantle bullets but also the new Bionic Yellow (non-lead) bullet, for use in jurisdictions that restrict lead, and the Evolution Power Bonded bullet. In terms of penetration, expansion and weight retention, the H-Mantle has proven itself all over the world. That alone gives RWS a standard against which to measure performance of its other products. Because of my supply limitation, I was unable to do penetration and expansion tests on either the Bionic Yellow or the Evolution Power Bonded bullets. That will have to wait, but given RWS's reputation for testing and perfecting its bullet designs, I would have no reservations about hunting with any of them.

Certainly, RWS ammunition is expensive, but it is premium in every way. Compared to the cost of a hunting trip these days, it's a small price to pay for such performance. 



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The rifle comes with an extreme weather hunting trigger that is first chrome plated then Ion bonded to prevent corrosion. The trigger breaks at a crisp 4lbs and is adjustable for take up and travel. The trigger is bladed to provide better tactile touch when shooting in cold conditions or with gloves.

The rifle has an extreme weather firing pin that is trilobial ground and chrome plated to prevent freezing. Tested to minus 65 degrees centigrade.

Unique barrel profile provides a perfect neutral balance to the rifle. The rifle naturally mounts to the shoulder and points instinctively.

Enhanced stock provides an improved cheek weld for accurate shooting, and a non-slip recoil pad.

Rifle length free floated hand guard allows the rifle to be accurately shot from multiple field rest positions. The longer hand guard protects the harmonics of the barrel from being disturbed by objects touching the barrel. The hand guard has four rail attachment points so accessories can be added as needed.

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Ruger SR-556 Takedown

*A Leupold Mark AR MOD 1
4-12x 40mm scope was
installed to test the SR-556
Takedown for accuracy.*

Brian Pearce

In 2009 Sturm, Ruger & Company announced the SR-556, an AR-15/M16 pattern rifle. In addition to many desirable features, it displays innovative engineering that has resulted in brisk sales. The latest version is the SR-556 Takedown, a simple but rugged design that measures around 18½ inches in length when disassembled. This compact package is handy for storage or travel but also increases the rifle's versatility and allows quick caliber changeover.

Disassembled
in Seconds
and Holds Zero



Takedown is simple: Lock the bolt carrier to the rear, then pull the slider bar (left) to the rear, twist the barrel assembly (below) clockwise, then slide the barrel unit out from the forearm. Reverse to reinstall.



The SR-556 Takedown is manufactured at Ruger's Mayodan, North Carolina, facility rather than the Newport, New Hampshire, plant where previous SR series rifles continue to be manufactured. The Takedown shares most of the same features of the original rifle. One new feature that was immediately noticed is that the 16.1-inch barrel is lighter weight, measuring .625 inch in diameter rather than the usual .700 inch diameter found on most other SR-556 series rifles. This brings the total rifle weight down to 7.6 pounds.

The premium, match-grade, chrome-lined, cold hammer forged Mil-Spec 41V45 barrel is constructed from chrome-moly vanadium steel. Close examination indicated precision rifling. Early press release information indicated the new Takedown would feature a one-in-7-inch rifling twist, but that is now changed to a 1-9 twist and is so indicated on the barrel. Many shooters consider this the best all-around twist rate for an AR pattern sporting rifle, as it will generally stabilize most bullets ranging from 50 to 75 grains, including bullets for varmints, big game and long-range match applications.

Another improved feature, when compared to previous tests with Ruger SR rifles, is a notably lighter trigger pull that broke on the sample at 4 pounds, 10 ounces. Ruger refers to this trigger as the Elite 452, which is two-stage and advertised with a 4.5-pound pull right out of the box. It features a full-strength hammer spring for reliable primer ignition with all primer types, including heavy cup mil-spec variants found on most 5.56 NATO ammunition, while the hammer is lightweight and results in a 30 percent

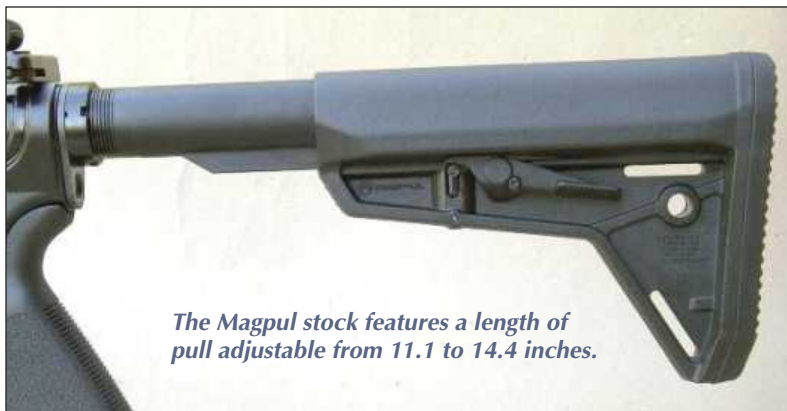
faster lock time over standard AR triggers.

The Magpul (MOE SL) buttstock is adjustable for length of pull from 11.1 to 14.4 inches, while the MOE pistol grip offers a handy latch-secured storage compartment for tools and such. The handguard features military-style, quad Picatinny rails and comes standard with three plastic rail covers.

One feature that has made the SR-556 distinctly different from its competition is its piston-driven gas system. There are several piston designs for AR-15 pattern rifles, some of which are controversial, but the Ruger system is well designed and has proven reliable. It offers a smooth power delivery to the bolt carrier that results in a longer life, but it also operates at lower temperatures and burns cleaner. To further increase longevity, the piston and bolt are chrome plated.

ton and bolt are chrome plated.

The gas system also includes an adjustable regulator that is positioned above the barrel and in front of the front sight. In short, it controls the amount of gas that is used to cycle the piston and bolt carrier. Loads vary significantly in gas volume. Some will overwork AR-pattern actions, while others are unreliable from lack of gas volume. The regulator allows the gas system to be "tuned" for specific loads to achieve the utmost in reliability and to deliver the correct volume of gases to the piston – which in turn cycles the bolt carrier – without overworking the action. There are four set-



The Magpul stock features a length of pull adjustable from 11.1 to 14.4 inches.

Ruger SR-556 Takedown

The barrel features a one-in-9-inch twist.



The rifle features a piston-driven gas system with an adjustable, four-position gas regulator.

tings: 0, 1, 2 and 3 that can be selected by simply turning the regulator. When set on 0, the gas is shut off so that the action cannot



Above, the SR-556 Takedown's flash hider is mounted on 1/2 inch x 28 muzzle threads. Right, barrel diameter is .625 inch.



cycle automatically; it can only be cycled manually, which is a really handy feature. Ruger suggests the 2 position as a starting point. If cases are being ejected to the rear, the gas port needs to be opened farther. If cases are ejected prematurely or being thrown forward, reducing the gas port opening (to a smaller number) will correct that problem.

The piston and regulator should be cleaned periodically, which is simple and takes only a few minutes to disassemble, clean and reassemble.

The takedown system is simple. With the rifle fully assembled, the barrel can be removed and the upper and lower receivers separated in less than 15 seconds, even when working at a somewhat ca-

sual pace. In disassembled form, it can be reassembled in even slightly less time. First, lock the bolt carrier to the rear and make certain the rifle is unloaded. Second, using the thumb and a finger, grasp both sides of the slider bar located at the front and lower sides of the handguard and pull it to the rear, then twist the barrel assembly clockwise (from the 12:00 position to the 1:00 position), which unlocks the barrel. Pull the barrel forward out of the handguard. The upper receiver and lower receiver can also be separated without tools by removing the takedown pin and pivot pin. These three assemblies are each approximately 18½ inches or less in length. Ruger supplies a handy, zippered nylon case with compartments to house the upper and lower



The front sight (left) is adjustable for windage and elevation, while the rear sight is adjustable for windage only. Both front and rear sights fold to permit scope mounting.



receivers and the barrel, but there is also room for magazines and a few accessories.

The barrel breech features eight locking lugs and has the headspace correctly set at the factory. When the barrel is locked in place, it is solid; there is no detectable looseness or movement. Time will tell the durability of this system, but it certainly appears Ruger has engineered it well.

Ruger also offers an extra barrel chambered for the .300 AAC Blackout that is likewise factory set with correct headspace and is available as an accessory.

The sights are branded as Ruger but are reported to be manufactured by Magpul. There are two folding apertures within the rear sight assembly, and both the front and rear sights fold down to allow scope mounting but are instantly available as needed. The front sight is fully adjustable for windage and elevation and stays with the barrel when it is removed. This is important, as it allows a given barrel to be sighted in, removed and reinstalled while retaining its zero.

Metal parts are coated with manganese phosphate and are hardcoat anodized, resulting in a durable, long-lasting, jet-black finish.

After removing packing oils, the sample rifle was zeroed using Hornady's TAP factory loads containing its 60-grain For Personal Defense (FPD) bullets. For the first 40 rounds, after every five shots, the barrel was completely cleaned with a light coat of oil wiped through the bore before the next five shots were fired. After the 40 rounds were fired, several five-shot groups were fired that hovered around one inch using the iron aperture sights.

A Leupold Mark AR MOD 1 4-12x 40mm scope was then installed using QR-style rings that, without tools, allow removal and reinstallation while holding zero. The scope also fits into the Ruger soft case. This scope is designed specifically for .223 Remington/5.56

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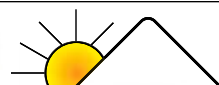
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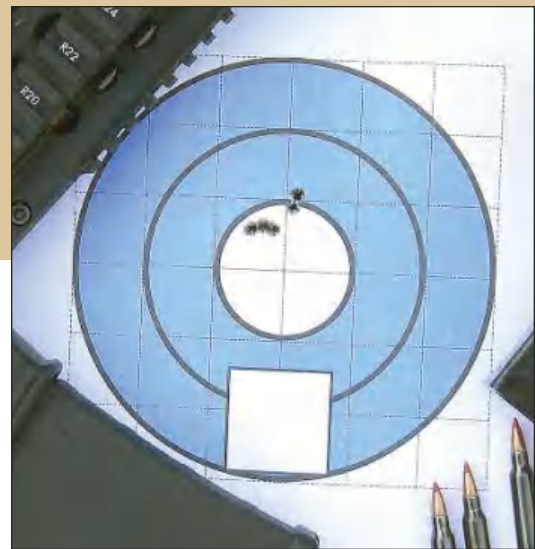
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Ruger SR-556 Takedown

NATO ballistics. It features 0.1 Mil P5 dial adjustments with a bullet drop compensator (BDC) dial, an adjustable objective, Multicoat 4 lenses and is sealed with an argon/krypton gas blend for absolute waterproofing. The main tube is one inch in diameter, which helps keep size and weight down, but it still offers enough magnification for practical hunting and even long-range work. Throughout testing the click adjustments were positive and held zero.

In addition to the Hornady .223 Remington factory load, several other loads were checked for velocity and accuracy. As can be seen in the accompanying table, the overall accuracy of the SR-556 Takedown was good. Of the eight factory loads tried, seven produced select groups that measured under one inch. The best single group, at just over .5 inch, was obtained using the Hornady 60-grain TAP FPD load. The only 5.56 NATO load available during testing was Federal's XM193 Ball that features a 55-grain metal-case, boat-tail bullet. The best group obtained with this load, fired from a rather hot barrel, was .95 inch.

One handload was tried that consisted of the Hornady 60-grain V-MAX bullet, NoslerCustom brass, Federal 205 Gold Medal Match



The SR-556 proved accurate with a variety of factory ammunition.

primers and 26.0 grains of Hodgdon Varget powder for around 2,850 fps. In trying this load with the bullet seated to three different overall lengths, a sweet spot was found that produced one group that measured .63 inch for four shots, but the fifth bullet opened the group to .97 inch. The next group performed similarly. With deadlines being what they are, I could not immediately determine the reason for the fliers. With some additional experimenting it can probably be discovered and corrected.

One experiment was conducted that is worth mentioning. I am always somewhat leery of detachable scopes, barrels, etc., returning to their zero – at least until they have proven reliable. Federal's 5.56 NATO Ball XM193 load had previously given three, five-shot groups that averaged 1.05 inches without touching the takedown system. An additional five

Ruger SR-556 Takedown Accuracy Results

load (grains)	advertised velocity (fps)	actual velocity (fps)	5-shot groups 3-group average (inches)
55 Barnes VOR-TX TSX	3,240	3,185	.80
55 Federal 5.56 NATO Ball XM193	3,132	n/a	1.05
55 Federal Nosler Ballistic Tip	3,240	3,183	.70
55 Remington AccuTip-V	3,240	3,146	.95
55 Winchester Pointed SP	3,240	3,204	1.30
60 Hornady TAP FPD	3,115	3,089	.75
60 NoslerCustom Ballistic Tip	3,000	2,945	.90
69 Buffalo Bore Sierra	2,900	2,919	.80

Ruger SR-556 Takedown Specifications:

Caliber: 5.56 NATO/.223 Remington
Stock: Magpul MOE SL
Handguard: quad Picatinny rail with three rail covers
Length of pull: adjustable from 11.1 to 14.4 inches
Barrel: cold hammer forged, match-grade, chrome-lined, Mil-Spec 41V45
Barrel twist: one in 9 inches
Barrel length: 16.1 inches
Action: AR-15 pattern, piston driven with adjustable gas regulator
Trigger: Ruger Elite 452, two-stage
Trigger pull: 4 pounds, 10 ounces
Sights: folding, windage adjustable rear, windage and elevation adjustable front
Weight: 7.6 pounds
Capacity: 30-round magazine (3 magazines supplied)
Finish: manganese phosphate/hardcoat anodized
MSRP: \$2,049

shots were fired, but the barrel was removed and reinstalled after each shot. Point of impact did not change, and the group size was only slightly larger (around .010 inch) than the average of three, five-shot groups that were fired without removing the barrel between shots. This is inconsequential, as the slightly larger group probably had more to do with taking the rifle off the sandbags and "breaking" my benchrest position between each shot.

The SR-556 Takedown is impressive. It holds its zero after its barrel is removed and reinstalled. It offers a match-grade, mil-spec barrel and has produced groups with premium ammunition that hover close to .5 inch. It has a respectable trigger pull and offers fast lock time. Barrels are also available chambered in .300 AAC Blackout, which can be changed over in just a few seconds, which adds to its versatility. It has good sights and a tough, durable finish. All these features, combined with the piston-driven, adjustable gas system, make it a truly outstanding AR-pattern rifle designed to meet the demands of today's shooters. **R**

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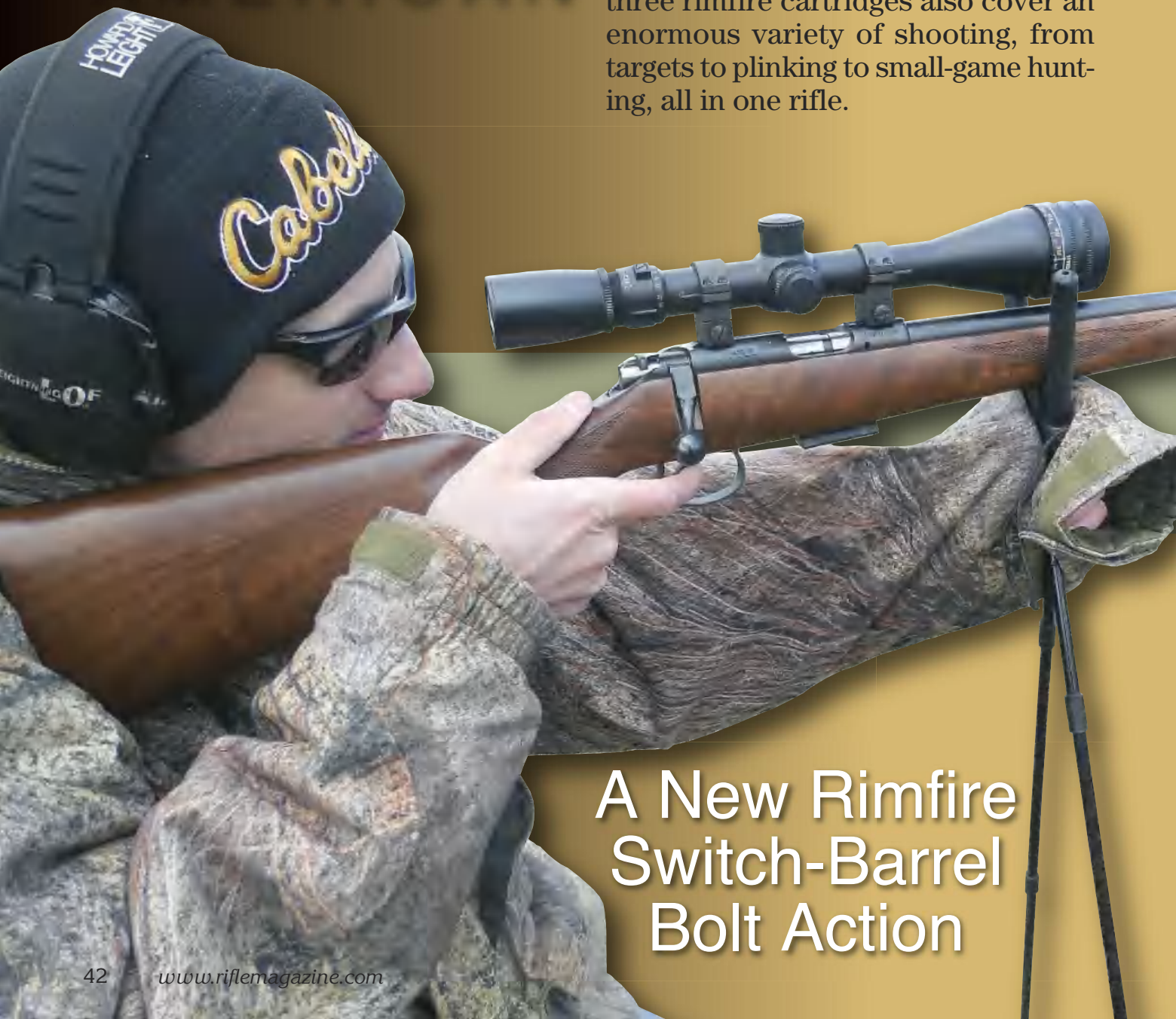
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CZ 455 AMERICAN

John Haviland

Options are good, and the CZ 455 bolt-action rimfire rifle's modular design offers several, allowing easily switching barrels to shoot .17 Hornady Rimfire Magnum, .22 Long Rifle or .22 Winchester Magnum Rimfire cartridges. In this time of rimfire cartridge shortages, it's nice to have the choice of shooting whatever cartridges are available on store shelves. These three rimfire cartridges also cover an enormous variety of shooting, from targets to plinking to small-game hunting, all in one rifle.



A New Rimfire Switch-Barrel Bolt Action

Barrel conversion is based on two screws that lock the CZ 455's barrel in place. The CZ "mini-set" barrel replacement kit (barrel set) includes wrenches to remove the original barrel and replace it with an included barrel chambered for another cartridge – and an appropriate magazine. My 455 American test rifle came with a .22 WMR barrel installed. The .17 HMR and .22 LR barrels included with the rifle were originally fitted to the rifle receiver at the CZ factory to ensure proper headspace. All three barrels have the same contour for a uniform fit in the stock's barrel channel, and their 20 $\frac{1}{2}$ -inch length keeps the rifle's balance the same. Barrel sets purchased separately from a rifle, though, must be fitted to an action to set the proper amount of headspace. A gunsmith should do this job because steel must be either removed from the rear shoulder or breech face of the barrel to attain correct headspace.

A Sightron 4.5-14x 42mm scope in CZ steel rings was used to test the 455 American. That large and high-magnification scope is probably unnecessary on a rimfire rifle, but the Sightron adjusts for parallax down to 25 yards, and its windage and elevation turrets have an easily readable adjustment scale.



CZ rimfire barrel sets come with wrenches and extra magazines for the Model 455.

By merely switching barrels, the CZ 455 can shoot (left to right): the .17 HMR, .22 WMR or .22 LR.



Removing two screws allows taking off a barrel from the receiver and replacing it with another in a different rimfire cartridge.



CZ's New Model 455

In 2010, CZ started replacing its Model 452 with the Model 455 as the basis for its bolt-action rimfire rifles. The 455 has been changed several ways to simplify manufacture. The barrel channel has a straight taper with plenty of room around a barrel, so the stock does not touch the barrel. That fits with a tapered contour of the barrel, with no step down in front of the receiver like the 452 had. The 455 has dispensed with the 452's second locking lug on the bottom of the bolt that latches into the bottom rear of the bolt raceway. With no clearance needed for a lug, the slots have been eliminated on the rear of the tang and top of the grip of the stock. That also leaves some extra thickness in the bottom of the receiver for the rear action screw to thread directly into the

receiver. A second action screw attaches to the front of the receiver.

This arrangement eliminated the 452's wood screw that attached the trigger guard/floorplate strap to the stock. The engaging face of the 455's locking lug, on the base of the bolt handle, is wide to provide full lockup in the bolt handle slot in the receiver. A slight forward angle to the slot provides



The 455's .22 LR magazine (left) has a U-shaped notch at the top front. The Model 452's magazine is on the right.



Inletting in the 455's stock (top) is much simpler than the 452's (bottom). The 455 has two screws that attach directly to its receiver.



The 455 (top) does not have a locking lug on the bottom of its bolt, like the 452 (bottom).

leverage to close the bolt and pull it open.

The two rifle's bolts are quite similar with two extractors that reach over the bolt face and a two-position safety. The 455 has to accommodate the .17 and .22 magnum cartridges, however, so the slot for the sear has been lengthened on the bottom of the bolt. The trigger remains pretty much the same on the 455, except the angle of the trigger rod is shallower. The trigger can be adjusted for pull weight by turning a nut on the rod. My 455's

trigger tripped at 2.5 pounds, and I left good enough alone.

The 455's magazine has a U-shaped notch at the top front, likely so cartridges feed smoothly. However, cartridges in the 452's .22 LR magazine feed just fine when inserted in the 455. The 455's .22 LR magazine also works slickly in a 452.

What has remained the same with CZ's rimfire rifles is the use of cold hammer-forged barrels, receivers machined from a single bar of steel and a rigid eye for detail. R

To develop a feel for switching barrels, I swapped out the .22 WMR barrel for the .22 LR barrel. The stock was removed with the supplied wrench; with a second wrench the magazine housing rear screw

was loosened two turns. The screw must be loose to keep it from blocking the bolt guide and preventing a barrel from fully seating. The .22 LR magazine fit in the magazine well with a spacer held with a pin. Both barrel retaining screws were removed along with the .22 WMR barrel.

The .22 LR barrel would not fit into the receiver, because the rear

sight bumped up against the scope. With the sight removed, the barrel slipped right into the receiver. Rotating between tightening the two retaining screws helped seat the barrel straightly in the receiver. The CZ barrel set pamphlet states the screws should be tightened to 6 Newton meters, or approximately 53 inch-pounds of torque. Bearing down with all my might on the screws with a Wheeler FAT

CZ 455
AMERICAN



Left, the .22 WMR and .17 HMR use the same magazine.



Right, a spacer is required for the .22 LR magazine to fit in the CZ 455.

Table 1

CZ 455 Barrel Set Impact Shift

barrel	load (grains)	five-shot group (inches)	second five-shot group* (inches)	vertical impact shift (inch)
.17 HMR	17 Hornady V-MAX	.54	.68	-.50
.22 Long Rifle	36 Federal copper-plated HP	1.12	.51	0
.22 WMR	30 CCI V-MAX	.79	1.20	-.30


* After removing and remounting the barrel.

Wrench tightened the screws the proper amount. Retightening the rear screw of the magazine hous-

ing and replacing the stock completed the job. It took only a few minutes to exchange barrels. Tak-

ing the stock off and replacing it took about the same amount of time.

At the range, the barrels were removed and remounted. I shot Federal .22 LR 36-grain copper-plated hollowpoint bullets to sight in the



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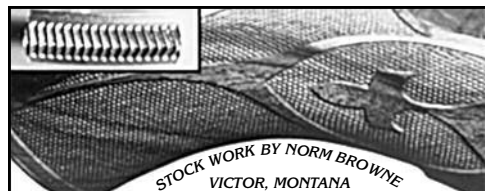
rifle at 50 yards then took off the .22 LR barrel and put it back on. Bullets from five more Federal shells hit the same place on the target.

The .22 WMR was next. I removed the .22 LR's magazine housing insert and retaining pin and screwed in the magnum barrel. With the .22 LR scope settings still in place, CCI .22 WMR V-MAX cartridges with 30-grain V-MAX bullets were right on for windage, but the scope's elevation had to be turned down 4.75 inches to dial in the V-MAX bullets to hit on aim at 50 yards. With the barrel removed and replaced, five bullets hit about .30 inch lower than the first group at 50 yards.

With the .17 HMR barrel in place, only five clicks down in elevation of the scope's .22 WMR setting were required for 17-grain V-MAX bullets to hit on the money at 50 yards. However, 47 clicks to the right were necessary to dial in windage. With the barrel switched out and back in, five bullets hit about .5 inch lower at 50 yards than the first group. I wrote down the three scope settings and saved them where they would not get lost.

An advantage of the CZ 455 switch barrel is that various loads of each rimfire cartridge hit nearly the same place at 50 yards. For instance, bullets from the three different .17 HMR loads landed within a .5 inch of each other. Four .22 WMR loads, with bullet weights from 30 to 40 grains, also hit within .5 inch of each other. There was a bit more bullet shift among five different .22 LR loads, but not so much a gopher would notice.

The gopher crusade started on a blustery day. Between snow squalls, I used the .22 LR barrel to roll a few of the little varmints. My son Thomas came along and said he would give the rifle a work-out,



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Three different .17 HMR loads shot nearly to the same place at 50 yards from the CZ 455.

but he saw no sense shooting .22 LR's when .17 HMR shells were available. We went back to the pickup and on the tailgate changed out the .22 LR barrel for the .17 HMR barrel and adjusted the scope.

The day finally warmed up and the shooting was hot. Thomas shot nearly 300 rounds by late afternoon. The next weekend he shot 500, which fairly well depleted the stockpile.

The .22 WMR barrel went on the CZ for the next outing. The rifle mowed over gophers pretty well, shooting CCI V-MAX cartridges loaded with 30-grain V-MAX bullets out to 100 yards. Past 100 yards and out to 200 yards, the .22 Magnum's bullets seemed to drop about twice as much as .17 HMR's 17-grain V-MAX bullets. "The .22 magnum is okay," Thomas observed, "when there aren't any .17 magnums to shoot."

A combination rimfire cartridge rifle makes sense financially and for fun. The .22 LR barrel covers a broad range of general shooting. The two magnum rimfire cartridges cost about four times as much but pay for themselves in increased performance. It's nice to have all those options in one rifle.

Table II
**CZ 455
Shooting Results**

load (grains)	group (inches)
.17 Hornady Magnum Rimfire	
15.5 Hornady NTX	.60
17 Hornady V-MAX	.77
20 Hornady HP XTP	1.61
.22 Long Rifle	
40 CCI AR Tactical RN Solid	1.29
36 Federal copper-plated HP	.81
36 Remington Golden HP	1.03
40 CCI Blazer RN Solid	.99
40 Lapua X-ACT RN Solid	1.04
.22 Winchester Magnum Rimfire	
30 CCI V-MAX	.61
30 CCI Maxi Mag +V JHP	1.39
30 Federal Premium Sierra HP	.85
40 CCI Maxi Mag JHP	1.18

Notes: Group size is the average of two, five-shot groups at 50 yards.

Four .22 WMR loads also shot fairly closely to the same place at 50 yards.



CZ 455

One rimfire to rule them all.



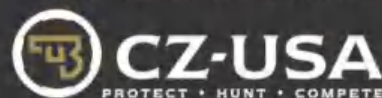
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Stan Trzoniec

Browning's line of bolt rifles has gone from the handsome Mauser variants with fancy wood and elaborate checkering patterns – the Safari, Medallion and Olympian grades made in Belgium – to the Japanese-made Browning Bolt Rifle (BBR) beginning in the late 1970s. In 1985 the A-Bolt made its debut, and in 1994 the A-Bolt II was brought on line. The more modern X-Bolt was introduced in 2008. Presently, the mainstream A-Bolt has been discontinued, with the AB3 taking its place with a limited selection of cartridge offerings.

For the dedicated, small-game hunter, the recently introduced X-Bolt Eclipse Varmint and Target models may be just the thing. Both models are the same in looks and feel with a slight difference in weight between the Varmint (9 pounds, 5 ounces) and the Target (10 pounds, 3 ounces) and cartridge selection. The Varmint version, reviewed here, is chambered for the .204 Ruger or .223 and .22-250 Remingtons and comes with a 26-inch barrel. For the Target gun, there is the 6.5 Creedmoor and .308 Winchester with longer 28-inch barrels. There also is a similar rifle called the Eclipse Hunter, with a short forearm that is designed for more general hunting duties and is chambered for



The Browning X-Bolt Varmint rifle was topped with a Weaver Grand Slam Varmint scope in Leupold rings and Browning bases for accuracy testing.



10 cartridges from the .243 Winchester to the .300 Winchester Magnum.

The Eclipse Varmint is long and heavy. For all-weather hunting, a good laminated stock is certainly a great choice. On this rifle, Browning went with the more traditional gray/black color – a subdued coloring great for field use in the shadows of the woods that encircle most fields in the East. For durability, the Browning catalog states the finish is a satin “varnish” (applied perfectly, by the way), which should do well in the field for years to come. The finish is very smooth to the touch and is applied uniformly without being overly reflective.

The forearm is very long, perhaps due to the 26-inch barrel length, but it's also good for stability of

the rifle and stock over the long run. From the magazine forward, it measures roughly 13 inches in length, sufficiently long enough for any shooting position in the field that might present itself. There is no checkering on the forend. Instead, finger grooves cover roughly half the distance from the tip to the start of the receiver. The barrel is free-floated in the stock up to the receiver to where it is glass bedded for enhanced accuracy potential.

Continuing with the stock, extensive inletting provides the necessary clearance for the magazine, surrounding floorplate and trigger guard. When the barreled action and bottom metal are removed from the stock, there does not seem to be much material left in this area.

When it comes to the rest of the

stock, the thumbhole grip seems to be a love/hate idea for some shooters. Most riflemen appreciate this type of stock simply because it is comfortable to shoot (especially offhand and with heavier calibers), while others complain that it's uncomfortable when shooting prone. Along with this stock type comes a somewhat sharper curve to the pistol grip, which is something to get used to on the range or afield.

Finishing the stock, we see the California influence is part of the design in that it includes a higher comb complete with a rollover cheekpiece. At the rear is the new Inflex Technology Recoil Pad. For sling-carry purposes, there are mounts for a quick-detach system, which unfortunately are not included with the rifle but seem to be available most everywhere. For bipod mounting, Browning has included a traditional sling swivel mounting just inches from the forend tip of the stock.

At the muzzle of the 26-inch barrel, the diameter is 0.910 inch with quality control assuring the barrel is triple-checked for interior finish and straightness and air-gauged for uniformity. Finally, the chamber is hand-reamed for the best in down-range accuracy.

The X-Bolt receiver has the Brown-



X-Bolt Varmint

Right, Browning employs a 60-degree bolt lift, allowing plenty of room for even the largest eyepiece on any modern scope.

Below, when the tang safety is applied, the bolt release button pops up; pushing it down allows the bolt to open with the sear locked to load, unload or change ammunition. Right, when the rifle is cocked, an indicator moves out from under the bolt shroud.



the base of the bolt handle is what Browning calls a “bolt unlock button” that works with the tang safety on the X-Bolt rifles. Pushing the safety forward allows the gun to fire and function in the usual manner. However, once setting the safety to “safe,” the “unlock button” pops up from the handle. This innovative addition allows the user to open and close the bolt with the safety “on” to add or remove a round from the chamber. Furthermore, this safety features a firing pin block as well as blocking the trigger sear for additional protection.

The Feather Trigger on the X-Bolt is probably one of the best I’ve tested in a long time. Engineered with a three-lever design, it ensures a crisp trigger pull without take-up or creep, all with minimal overtravel. Right from the box, the test rifle’s trigger registered a pull of 3½ pounds with such a small amount of movement that it was hardly noticeable. Everything about this mechanism is first-class, from its alloy trigger housing to its chrome-plated components.

Like other X-Bolt models, the magazine is detachable and constructed from a lightweight polymer. It is designed so each round gets a direct, straight-in entry into the chamber and is very easy to load and remove from the rifle. For the Varmint version, capacity is six rounds for the .204 Ruger and .223 Remington and five rounds for the slightly larger .22-250 Remington.

ing straight-wall design, and the proportions of the action coincide with the cartridge length with plenty of room allowed for positive extraction and ejection through the ejection port. On the left side is the traditional bolt release with the rear half serrated. Like the receiver, the bolt follows with flat sides, and there’s the option of having your name engraved on the outward facing flat in either block or script.

Bolt lift is a short 60 degrees, because three locking lugs reside on

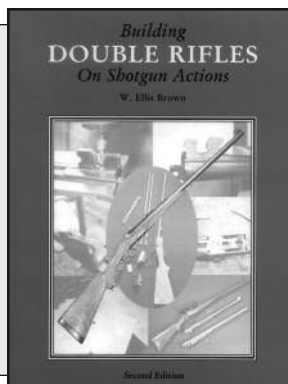
the head. For strength, the bolt is machined from a block of solid steel bar stock, then fitted with precision to the chamber. At the bolt face, a rugged blade-type extractor works in tandem with a plunger ejector. The body of the bolt is polished with the bolt handle and shroud finished in a deep blue/black to match the rest of the action.

The bolt handle is novel in a couple of ways. First, the bolt knob is canted about 30 degrees to aid in grabbing it for follow-up shots. At

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Specifications: Browning X-Bolt

Model: X-Bolt

Action: bolt action, magazine fed

Stock: laminated gray thumbhole

Cartridge tested: .204 Ruger

Cartridges available: .223 Remington,
.22-250 Remington, 6.5 Creedmoor,
.308 Winchester

Barrel length: up to 28 inches with the
Target model

Overall length: 45 inches (.204 Ruger)

Sights: none furnished, drilled and tapped

Weight: 9 pounds, 5 ounces

Finish: satin finished all around (action,
stock)

Options: none

Price: \$1,069.99 (all calibers)

Manufacturer: Browning Arms
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Morgan UT 84050
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Above, there is hardly any trigger take-up before the sear is released.

Right, the trigger assembly is well made, and although it can be adjusted, it is preset at the factory; note the hint of red thread locking medium.



The X-Bolt's scope mount design features four screws per base as opposed to the more traditional two-screw arrangement. With four screws, the theory is that the hold-

ing power to the receiver is much greater; the bases are secured to the receiver at all corners for better contact to the top receiver bridges of the rifle.

For optics, a new Weaver Grand Slam 4-16x 44mm scope was mounted in Leupold rings. While it does look like it is touching the barrel in the photo, I could slip a

single sheet of paper between the two. Moving the scope forward will widen the clearance, but for proper eye relief and range testing, I left it where it was. This new scope is made for small-game hunters and features parallax adjustment on its side (rather than the adjustable objective lens). The scope is fast to use, crystal clear and has a newly designed ocular

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X-Bolt Varmint

The X-Bolt is equipped with a lightweight, detachable polymer magazine that holds six rounds of .204 Ruger ammunition.



The cheekpiece is rather full and has a rollover comb.



Browning X-Bolt Rifle Range Tests

load (grains)	velocity (fps)	group (inch)
32 Hornady V-MAX	4,104	0.780
40 Hornady V-MAX	3,862	0.620
32 Remington AccuTip-V BT	4,093	0.260
40 Remington AccuTip-V BT	3,759	0.690

Notes: All loads tested at 100 yards with the best groups shown here. Wind was light at 10 mph; temperature was 65 degrees Fahrenheit. All loads chronographed over an Oehler Model 35P set 10 feet from the muzzle.

bell and focus adjustment. Mine was equipped with the Varmint EB-X reticle, with fine lines on the crosshairs denoting holdover and wind compensation etched in.

The .204 Ruger is essentially the .222 Remington Magnum case necked down to .20 caliber. While only factory ammunition from Hornady and Remington was used for this test, I have handloaded the .204 Ruger in a Ruger No. 1 with a 26-inch barrel, so it did give me a bit of a comparison. While those handloads did give some small groups, today's factory ammuni-


tion is not too shabby. With the Ruger No. 1, the smallest group with handloads went .650 and .670 inch with Hornady 32-grain V-MAX bullets at 3,956 and 3,917 fps, respectively. With Hornady factory ammunition using the same load, three shots, averaging 3,972 fps, grouped .750 inch.

Using the Browning test rifle with the same Hornady factory ammunition, the best group hit .780 inch with an increase in velocity of 4,104 fps. Hornady's 40-grain V-MAX load grouped a tad smaller, .620 inch at 3,862 fps. Remington



The smallest group Stan shot with factory ammunition measured .260 inch.

32-grain AccuTip-V BTs placed three shots into two holes, however, to bring the all-time best group of the day to .260 inch at 100 yards. Finally, Remington 40-grain AccuTip-V BTs went into a group of .690 inch at 3,759 fps.

For the dedicated small-game/varmint shooter, this new Browning X-Bolt Eclipse Varmint rifle may prove interesting. Given its weight, it's nice to see the shots hit the target without any muzzle rise, although the rifle may be a bit much to bear while walking around the local fields. 

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Why One Curious Rifle Didn't Survive

M1 GARAND AND

Mike Venturino

Photos by Yvonne Venturino

In my teens, I commonly hung around Williamson, West Virginia's modest gun club, and anytime one of the older members offered to let me shoot their rifles, they were never turned down. One day a fellow pulled an odd-looking rifle from a case and allowed me to try his "Johnson" .30-06. Despite

its obvious military origins, I remember distinctly thinking it reminded me of a snake that had swallowed a rat. Never did I hold another Johnson until the week before this writing, when a friend offered one for a brief loan. It still reminds me of a well-fed snake, yet it was the only true contender to the M1 Garand as America's standard issue semiautomatic battle rifle.

Seventy-five years ago, the two rifles' stories intertwined briefly. The M1's beginning was in the 1920s when John C. Garand was hired by the government-owned Springfield Armory and soon was instructed to develop a semiautomatic rifle for the U.S. Army. John Pedersen was also put to work toward the same end. In fact, he was responsible for the .276 Pedersen cartridge, for which the two rifles would be chambered when tested.

By the early 1930s, the two rifles were ready, and after considerable testing Garand's development won the competition. That's when the U.S. Army's Chief of Staff Douglas MacArthur made one of the few truly great decisions of his career. He refused the .276 Pedersen cartridge, causing Mr. Garand to go back and redesign his rifle for the government's .30-caliber round (.30-06). It is often written that MacArthur's reasoning was that huge stocks of .30-06 ammunition were on hand. It seems more logical, however, that switching over to a new cartridge would have necessitated redesigning all the thousands of John M. Browning's machine guns and the Model 1918 BAR already in service.

Regardless, the M1 Garand was adopted by the U.S. Army in January 1936. Initially M1s had 22-inch barrels, weighed approximately 9 pounds and had a magazine capacity of eight rounds that were fed into the rifle by means of an enbloc loader. (An enbloc loader actually goes into a rifle's magazine with the cartridges and then is ejected when the last round is fired, as opposed to a clip that is used to feed cartridges into a magazine but never actually enters the rifle's mecha-

nism.) The M1 was built as a robust battle rifle. Its stock is nearly full length, covering and protecting the entire action, magazine and gas system with an accompanying handguard atop the barrel to protect the shooter's support hand from barrel heat.

As with any new device, there were some bugs to iron out. Initially the M1's gas system operated by trapping gas at the muzzle and then using it to cycle the action. The gas trap gave some problems, not least of which was it flying off at times. By October 1939, the U.S. Army's Ordnance Department decreed that the gas-trap system was going to be replaced with a port near the muzzle through which gas could pass for operating the M1's piston. The idea was that M1s already in the field would be recalled and converted. Thereafter, M1 Garand barrels were 24 inches in length.

Interestingly, the U.S. Marine Corps did not immediately jump on the M1 Garand bandwagon. As a military organization, the USMC was more concerned with individual marksmanship than the U.S. Army and clung to its Model 1903 Springfields for five years after the M1 became the army's standard rifle. The primary reason was the '03's superb reputation for accuracy.

In the mid-1930s, Melvin M. Johnson, a Harvard law school graduate, decided to try his hand at firearms designing. He was aware of the M1 Garand and its early rival, the .276 Pedersen rifle, and thought he could better both. His idea was to have a recoil-operated mechanism, eliminating the need for gas to function the action. For this to occur, the barrel needed to move slightly backward in recoil to unlock the rifle's

M1941 JOHNSON

Facing page, the Johnson M1941's rotary magazine was loaded using two, five-round stripper clips, the same as used for M1903s. The M1 Garand (below) was fed with eight-round enbloc loaders. Note the "locking bar" rear peep sight of World War II vintage, arguably the best rear sight ever put on a battle rifle.



M1 GARAND AND M1941 JOHNSON

bolt. Without a gas system, Johnson felt his rifle needed no full-length stock, so about half of its 22-inch barrel was exposed. Instead of a wood handguard to protect the shooter's hand from barrel heat, his rifle used a perforated metal variation. This brought rifle weight down to a nominal 8½ pounds.

Johnson's early prototypes used straight magazines into which fed .30-06 cartridges in five-round stripper clips. Soon, however, he devised a rotary magazine of 10-round capacity that could be fed by five-round stripper clips or with individual cartridges. This change is what gave the Johnson rifles the distinctive bulge that made me think of a snake that had swallowed something. Seventy-five years ago, military organizations worldwide still felt that a battle rifle needed a bayonet. (The Japanese considered a bayonet more important than the rifle itself.) Because the Johnson rifle's recoil-operated action needed the barrel to move slightly, the added weight of a bayonet caused functioning problems.

Since Johnson held a commission as an officer in the USMC Reserve, and since the Corps had not yet adopted a semiautomatic rifle,

The Johnson M1941, turned on its side, has a five-round stripper clip inserted into the loading port.



Below, John C. Garand's semiautomatic competitors were the Johnson (left) and John Pedersen's .276. Right, the M1 Garand was developed for the .276 Pedersen, but U.S. Army Chief of Staff Douglas MacArthur insisted on using the .30-06.



he hoped to sell his new rifle to the USMC and later perhaps to all U.S. military organizations. It didn't happen. If the M1 Garand had not been undergoing some birthing problems in the late 1930s, the Johnson rifle might never have seen the light of day.

The M1 was coming under fire to the point that many U.S. congressmen and senators wanted to know if the army had adopted a faulty firearm after so many years of development. Therefore in May 1940, an informal shoot-off was held between the M1 and Johnson's prototypes. The shoot was attended by politicians and U.S. Army officers. According to Bruce M. Canfield's book *U.S. Infantry Weapons of World War II*, both rifles passed the tests equally, but because the M1 was already in production, no one of importance found a need to replace it with the Johnson. Later that year, the USMC tested the M1, the Johnson and an entry by Winchester Repeating Arms. The Marine testers rated the M1 first, the Johnson second and Winchester's offering last.

With that rejection, Johnson and his backers looked for foreign clients and formed the Cranston Arms Company in Cranston, Rhode Island. There they began manufacturing what was termed the Model 1941. The primary customer at that time was the Dutch government-in-exile, and the purpose it had for buying M1941s was to better arm forces in the Dutch East Indies, because the Japanese coveted the natural resources therein. Interestingly, the Dutch ordered rifles chambered

for .30-06. A few thousand of the M1941s were shipped before Japan attacked and within months conquered the Asian holdings of the United States, Great Britain and the Netherlands. This left the Cranston Arms Company with thousands of new rifles and no place to ship them.



With the borrowed Johnson M1941, the best groups were these two of about 4 inches. The bottom five shots were Federal 150-grain M1 Garand loads, and the top group was with Hornady 168-grain M1 Garand loads.

Evidently the USMC had not forgotten the Johnson entirely, and because the U.S. Army received priority on M1 Garands, a deal was made with Cranston Arms Company for several thousand Model 1941s; the rifles even accepted the same five-round stripper clips the USMC was already using. As for the bayonet problem, Johnson had developed a small, all-metal bayonet with which his Model 1941 did function reliably.

The Model 1941 was designed with an easily removed barrel so those purchased by the USMC went to the Paramarines. They were used in combat in the South Pacific island battles for Tulagi, Guadalcanal and Bougainville. According to Canfield, some were field tested by the USMC Raiders but never used in combat by them. Because they could be bro-

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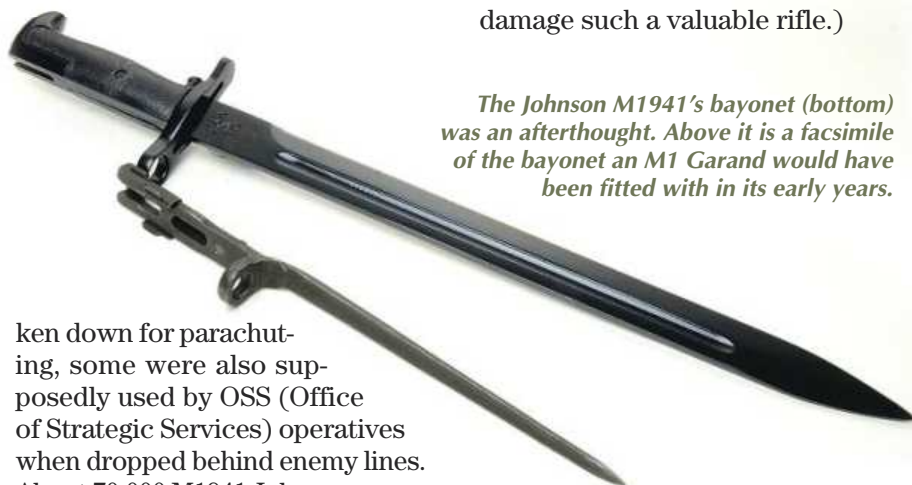


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M1 GARAND AND M1941 JOHNSON



The Johnson M1941's bayonet (bottom) was an afterthought. Above it is a facsimile of the bayonet an M1 Garand would have been fitted with in its early years.

ken down for parachuting, some were also supposedly used by OSS (Office of Strategic Services) operatives when dropped behind enemy lines. About 70,000 M1941 Johnsons were made between 1941 and 1944.

Evidently not all that many have survived the ages, because their prices in the twenty-first century are startling, which is the reason I don't have one. It's also the reason I jumped at the chance to have a loaner M1941 here for a few weeks. By the serial number information in Canfield's book, this one is in the 16,000 range of production. (M1941s were given a letter prefix after each 10,000 made. This one's serial number begins with an A.)

As far as I can tell, it is still in original military configuration, but of course, I have no expertise on which to base that. I did shoot it with about 50 rounds side by side

with one of my World War II vintage M1 Garands, so a few opinions were developed. (I stopped shooting it after that amount, because a small chunk of stock chipped off in front of the magazine – and I didn't want to further damage such a valuable rifle.)

First, it is an uncomfortable rifle to carry in one hand. Its balance point is precisely at the large magazine swell. By comparison, the M1 Garand is downright comfortable to carry one-handed, albeit at least a pound heavier. Another comfort factor is recoil. I've fired Garands off and on for decades and find their recoil completely unobjectionable. The first shot fired through the M1941 caused me to reach for my shoulder pad. Perhaps it's just a trait of a recoil-operated rifle, or perhaps it's due to the lighter weight, but to me the Johnson kicks more like a .30 magnum than a .30-06. My '03s weigh no more than the M1941, but their felt recoil isn't as much.

The rear peep sight on an M1 Garand is a gem. I doubt there was ever a battle sight more agreeable to good shooting, and that includes the early "locking bar" type on my M1 as well as those more refined post-World War II versions mostly seen today. Windage and elevation can be moved incrementally and then brought back to zero. By comparison, the M1941's rear sight is a bit more than rudimentary but nothing fancy. It can be adjusted to 1,000 meters, not yards, (Remember these were ordered by the Dutch.) by lifting and sliding the rear peep to the num-

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Perhaps the Johnson's primary advantage compared to the Garand is its magazine. Not only can the M1941 be fed by five-round stripper clips of which the U.S. military had millions already, but its magazine could also be topped off by single rounds. Conversely, the M1 was loaded with its eight rounds and that was pretty much it. If a soldier had fired several rounds during a fight but not all eight, there was only one way to bring the Garand back to fully loaded. That was to eject the partially empty enbloc loader and put a fresh one in. That was about the only criticism of the Garand deemed valid by the U.S. Ordnance Department and led to the use of a 20-round detachable box magazine for the later M14. (One must wonder how matters would have played out if Garand had designed the M1 for a 10-round detachable box magazine in the beginning.)

A couple more points were in the Garand's favor in the early 1940s. Its safety in the front of the trigger guard was perhaps the best ever developed for a battle rifle. A shooter merely had to bump it forward with his trigger finger to push it into the "off" position. In fact the idea was so good that it has always been standard on Ruger's semiautomatic "Mini" rifles.

Lastly, there was the matter of the bayonet. With the relatively weak and exposed barrel of the M1941, bayonet fighting would likely have resulted in its damage, though I have found no proof. The M1's barrel encased in wood was protected for such endeavors. By 1941 many scorned bayonet fighting, but it was common in the first years of World War II when fighting the Japanese.

Except as a military curiosity on the surplus market, after 1944 the Johnson rifle dropped into history. I feel fortunate to have had a chance to handle and shoot one. 

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Considered in all its styles and calibers, more SAAs were made from 1873 to 1900 than any other single type of American revolver. However, it was not the only handgun about, nor was it the first revolver to take the then new metallic cartridges. From 1870, when the era of metallic cartridge firing sixguns began until 1900 which is generally considered the end of the Wild West, Colt, Remington, Smith and Wesson, Merwin & Hulbert, and a few other lesser known companies collectively produced hundreds of thousands of metallic cartridge firing sixguns. These handguns were at least of comparable quality to the Colt SAA, and some exceeded it by a wide margin. As far as actually shooting such guns, aside from the Colt Peacemaker, very few Old West sixguns have ever been put back into use. That has started to change, and this has probably come about from the enthusiasm generated by the great sport of cowboy action shooting.

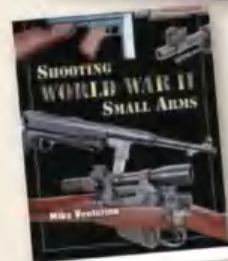
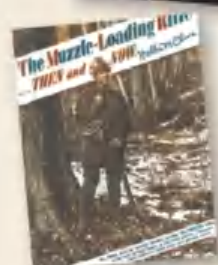
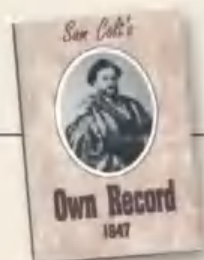
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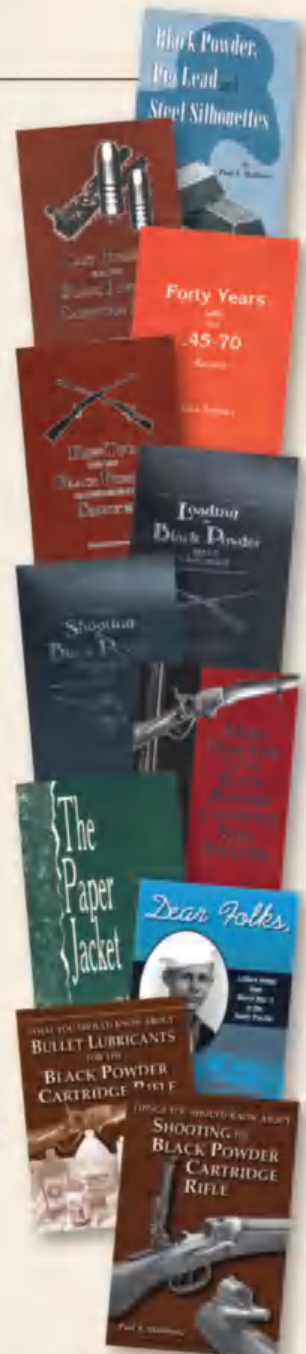
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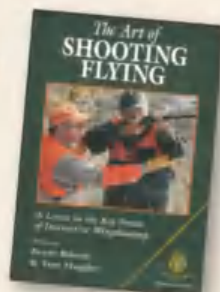
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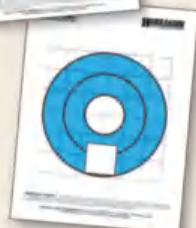
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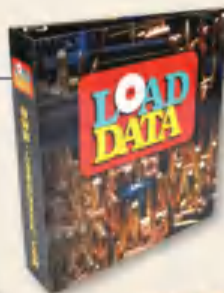
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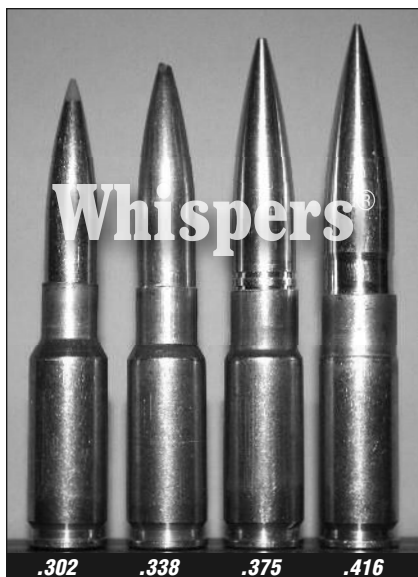
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Down Range

(Continued from page 16)

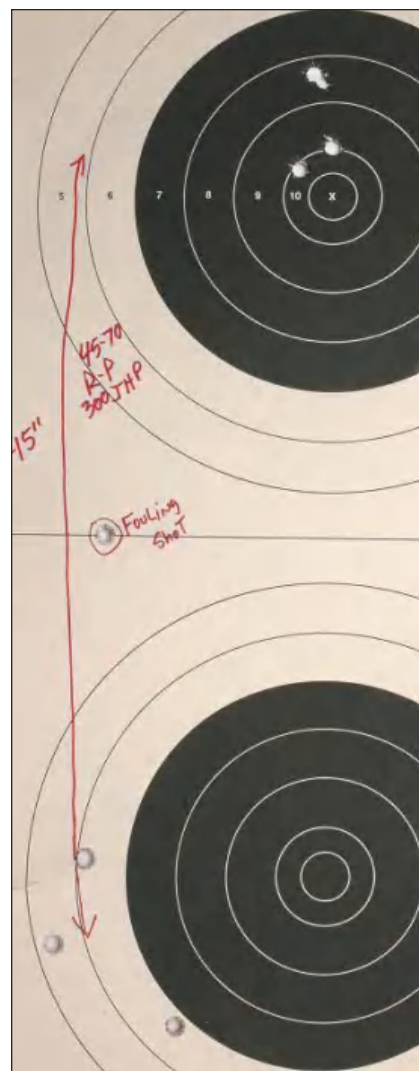
Those long strips of paper are also great for determining bullet drop. I first shoot the top bull at 100 yards until I have point of impact where I want it, then back the target off to 200 or 300 yards and shoot again at the top bull. Instantly, I can see the actual trajectory of a rifle/load combination.

A fairly recent innovation in regard to targets is the "shoot and see" type wherein the bullet's hole is outlined by a highly visible color. Although relatively expensive, they save time and ammunition, because light conditions can cause even large bullet holes in black bullseye paper targets to appear invisible. Put on heavy stock, they also resist tearing loose on windy days, which can definitely be a problem here in Montana. A third benefit of these targets is they look great in photographs.

Let's go back to the National Target SR. For some reason the traditional American range for shooting rifles at paper targets is 100 yards. Yet by having my own range to 300 yards, I've learned that shooting at distance often gives a much better idea of rifle and load performance, not to mention a shooter's ability.

When test-firing black powder cartridge match rifles (BPCRs), I put up two of the SRs at 300 yards. Since I have two rifles chambered per cartridge, both are usually tested with loads at the same time, because there is no sense in having a backup rifle for competition that doesn't shoot well with the same load as the primary rifle. Each rifle is "assigned" its own target in the beginning, making it easy to ascertain how specific loads perform from each. These target rifles have peep and/or optical sights adjustable in minute-of-angle increments. With so much paper out there, many groups can be fired without interruption for replacing targets.

The color of bullseyes is an important consideration. Black used



Mike uses National Target Company's A25 to determine bullet drop by sighting in on the top bullseye, then moving the target to a farther distance and shooting once more at the top bullseye.

to be standard, but seeing bullet holes was sometimes problematic, depending on the sun's position in the sky. Nowadays many bullseyes are red, orange or blue. In fact, Wolfe Publishing sells some excellent targets with both grid patterns and blue bullseyes. Visibility of bullet holes in blue is improved regardless of light conditions.

A few years back, a friend with a lifetime of firearms instruction experience visited. In my office he spied a messy stack of used targets and said, "I'm glad to see that." When I asked why, he said, "It shows just how much shooting you do." He would have been even more impressed to view the large array of target types in my "shoot-ing shack."

R

Mostly Long Guns

(Continued from page 15)

pending on front sight size and shape. A diamond-shaped bullseye allows the front sight to just "touch" the bottom of the diamond, with the bottom of the diamond being precisely centered in the middle of the front sight (bead or blade). Round, square and other bullseye shapes can also work well. Regardless, I prefer to place the target on a light tan or off-white background that is large enough to "surround" the front sight, which generally helps in achieving a flawless sight picture.

Many vintage sights tend to glare, skewing the sight picture, but can be smoked or blackened. Always focus on the front sight and target, and carefully center the front sight in the (probably) slightly blurred rear sight (aperture or open). There is no parallax, and with practice it is remarkable how accurate open and especially aperture sights can be.

Like any rifle, leverguns have ammunition preferences and should be tested for accuracy using a variety of factory loads or handloads. Most leverguns are capable of respectable accuracy – not benchrest competition accuracy but certainly good enough for the distances they were intended to take game. For example, I have a vintage Winchester Model 1886 .45-70, a Model 53 .25-20 WCF and others that will stay inside 1.5 inches at 100 yards if I do my part, while modern Browning and Winchester/USRA 1886s, '95s and '53s (manufactured by Miroku) exhibit similar accuracy and have occasionally proven capable of MOA groups. Marlin leverguns (1894s, 336s, 1895s) from all vintages and in many calibers frequently produce similar accuracy.

Load development, good sights, shooting techniques and skills are essential in maximizing accuracy. Once that is worked out, lever actions are truly great field rifles with heritage. R

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Walnut Hill

(Continued from page 70)

the bullet would – or could – in whole or in part, balance the effect and bring the bullet back into the line of sight.

From this reasoning emerged the British custom of imparting a left-hand twist. A quick check of English rifles readily at hand, however, indicates the practice was far from universal. Starting with the earliest, a Snider-Enfield from the 1860s, I found a right-hand twist. A Woodward double rifle, circa 1874, and a Holland & Holland double from 1895 have right-hand twists in both barrels. Some British double rifles may have different twist rates in right- and left-hand barrels to offset the effects of recoil on barrel regulation, but not these two. A Ross Model 1905 has a right-hand twist, as does a Ross Model 1910. Conversely, all the Lee-Enfield variants I looked at have left-hand twists.

Exactly how much of an influence any of this has is open to question, especially with high-velocity bullets at close range. Undoubtedly, the Coriolis Force plays a significant role in gun-laying for artillery monsters like the German Paris Gun of 1918. It fired a projectile up to 75 miles, left the Earth's atmosphere en route and was in the air for about three minutes. In three minutes, the Earth's rotation can certainly have an effect.

Since all the records relating to the Paris Gun were destroyed when defeat became imminent, all we know about it now is basically hearsay. However, a few artifacts survived, including one shell; each shell had copper driving bands with grooves to fit the rifling in the barrels. Clearly, it is a right-hand twist.

The idea that one could compensate for the Coriolis Force with rifling is great in theory, but there are obstacles. One is that the force varies according to latitude, being greatest near the equator, but almost nothing at the North Pole. Then there is the question, considering the fact that the British Em-

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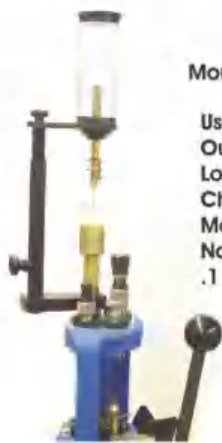
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pire spanned the globe, including both northern and southern hemispheres, of knowing exactly where the rifle might be put to use. As with the Paris Gun, compensating for the Coriolis Force is best done on a shot-by-shot calculation, aiming the gun accordingly.

Today's ultra-snipers, attempting shots at 2,500 yards, would have to compensate to some extent, but whether it is possible to build adjustments into a scope is another question. Some scopes already take into account elevation, temperature and angle up or down, but those are constant factors, whereas the Coriolis Force varies according to latitude.

Eventually, someone will come up with a computer program that automatically adjusts the scope reticle and will be able to build in all of these factors. For all I know, they may already have it. For the average shooter, however, the Coriolis Force would be so minimal, even at great distances, that trying to calculate it, and compensate for it, would be a recipe for insanity.

In case you're wondering, I came across the information about left-hand twist in the Lee-Enfield in the 1929 edition of the *Textbook of Small Arms*, a professional publication issued at irregular intervals by the British War Office since 1863. It began as a pamphlet for officers in training at the School of Musketry at Hythe and gradually evolved into one of the world's great textbooks on rifles.

Later editions expanded to include everything from machine guns and hand grenades to bayonets and cavalry swords. As the amount of information mushroomed beyond all control, much of the earlier stuff was squeezed out. Still, anyone interested in rifles should have as many different editions as can be found. It makes fascinating reading.

It is also a valuable indication of the attitude of the Victorians to science, research and learning. For a comparison to how their world changed, look at a comparable 35-year period from our own time.

Computers began coming into general use in 1980, and look where computers are today, including smartphones, iPads and digital riflescopes. Now think about the changes in firearms between 1880 (black-powder centerfire cartridges, with work on smokeless powders in its earliest stages) and 1915, when there was war in Europe,

and the Paris Gun was already on the drawing board.

We often refer to that as "a simpler time," when life was slow, stable and predictable. For the Victorians and Edwardians, it was anything but predictable – certainly in terms of the rifles they were shooting. R

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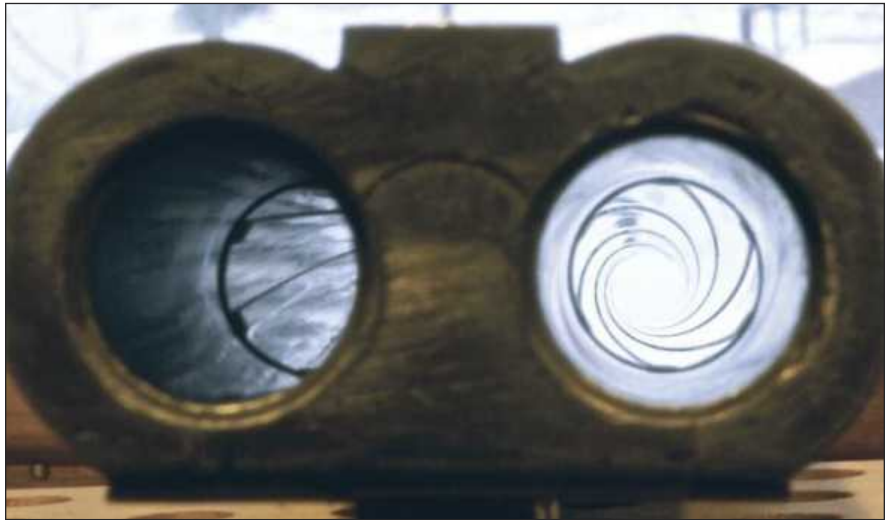
CORIOLIS FORCE AND LEFT-HAND RIFLING

WALNUT HILL by Terry Wieland

Writing about rifling is easy. Knowing where to start is difficult. So, skipping lightly over several centuries of theory and practice, trial and error, here is The Vital Question: Why did the British rifle their barrels with a left-hand twist, while the rest of the world used a right-hand twist? A hint: It has nothing to do with the fact that they also drive on the left. Another hint: It has its basis in sound, scientific reasoning. And finally: The sound, scientific reasoning dates back to 1651 and the scientific studies of an Italian Jesuit priest.

If, like me, you tended to skip physics and go hunting instead, you may have missed the lecture on the Coriolis Force. This is the effect of the Earth's rotation on projectiles, among other things. In the 1600s, Jesuit scholar Giovanni Riccioli illustrated how a cannon ball, fired north, should, if the Earth in fact rotated, land to the east of its target. More than a century later, a French scientist named Gaspard G. de Coriolis expanded on the theory and gave his name to the physical effect.

Riccioli's apparent motive was not to prove that a cannon ball



The rifling in this 1895 H&H double rifle not only has a right-hand twist, but also contrary to myth, both barrels have the same twist direction.

would indeed deviate east, but to use the fact that it could not be demonstrated to do so as evidence that the Earth *did not* rotate. By doing so, he would discredit Copernicus and Galileo, which would please the Vatican. Instead, he proved his own theory correct, thereby managing to be both right and wrong at the same time – quite a feat, even for a Jesuit.

The upshot of all this scientific and religious study and argument was general agreement in the 1800s that the Earth did rotate, that such

a force in fact existed, and that it could have a discernible effect on a bullet, cannon ball or, later, artillery shell. The theory stated that the effect in the northern hemisphere would be the reverse of the effect in the southern.

Until about 1850, theories of rifling had been fairly rudimentary because of the complication of black-powder fouling and the difficulty of fitting bullets tightly to take the rifling. With the emergence of centerfire cartridges, it was possible to fine-tune rifling to a much greater degree than ever before. Such rifle experts as Charles Lancaster, William Metford, Alexander Henry and John Rigby applied their talents to designing the most accurate rifling possible.

Somewhere along the line, the Coriolis Force reared its head, and rifling designers applied their fertile brains to its effects and how it might be counteracted. Since they knew that it would cause a bullet to stray to the right, they reasoned that imparting a left-hand spin to

(Continued on page 68)

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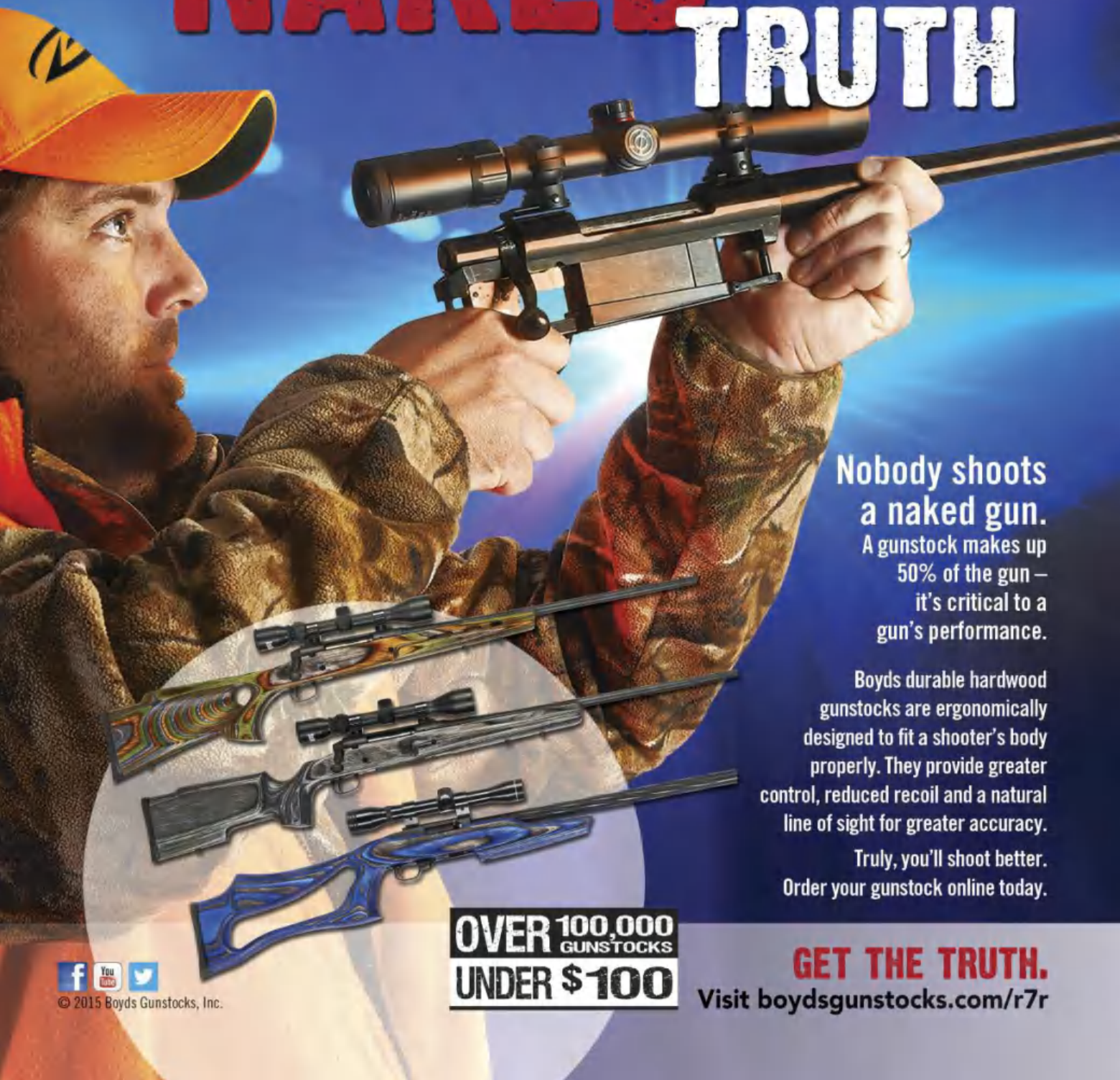
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